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**A revision of the tropical/temperate amphipod genus
Dulichiesta Stout, 1912, and the description of a new Atlantic
genus *Verdeia* gen. nov. (Crustacea: Amphipoda: Melitidae)**

J.K. LOWRY & R.T. SPRINGTHORPE



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Abstract

The melitid amphipod genus *Dulichchiella* Stout, 1912, is revised. Based on examination of type material or new material from near type localities, we redescribe *D. anisochir* (Krøyer, 1845) from Brazil, *D. appendiculata* (Say, 1818) from the south-eastern United States, *D. australis* (Haswell, 1879) from eastern Australia, *D. cotesi* (Giles, 1890) from the Andaman Islands, *D. cuvettensis* Appadoo & Myers, 2005 from Mauritius, *D. fresnelii* (Audouin, 1826) from the Red Sea, *D. pacifica* Lowry & Springthorpe, 2005 from Australasia and *D. spinosa* Stout, 1912 from California. Based on published illustrations and new material we describe six new species: *D. guinea* **sp. nov.** from western Africa; *D. lecrovae* **sp. nov.** from the south-eastern United States; *D. oahu* **sp. nov.** from Hawaii; *D. terminos* **sp. nov.** from south-eastern Mexico; *D. tomioka* **sp. nov.** from Japan and *D. tulear* **sp. nov.** from Madagascar. The new genus *Verdeia* is described for two established species, *Melita grandimana* Chevreux, 1908 from the Cape Verde Islands and *Melita subchelata* Schellenberg, 1925 from Namibia. We provide a key to the world species of these genera.

Key words: Amphipoda, Melitidae, *Dulichchiella*, *Verdeia*, new genera, new species, taxonomy

Introduction

During the nineteenth century a number of amphipod species were described in what is currently known as the distinctive genus *Dulichchiella* Stout, 1912. Males of these species are among the most immediately recognisable amphipods in shallow warm-water seas, mainly because of the asymmetrical male second gnathopod which can be nearly as large as the body. Between 1818 and 1890 nine species were described: *Gammarus appendiculata* Say (1818) from Georgia in the south-eastern United States; *Gammarus fresnelii* Audouin (1826) from Egypt, almost certainly the Suez side; *Gammarus anisochir* Krøyer (1845) from Rio de Janeiro, Brazil; *Gammarus (Maera) validus* Dana (1852) from Singapore; *Gammarus (Maera) setipes* Dana (1852) and *Gammarus (Maera) pilosus* Dana (1852), both from Rio de Janeiro, Brazil; *Melita exilii* Müller (1864), from an unknown locality; *Melita australis* Haswell (1879) from Port Jackson, Australia and *Melita cotesi* Giles (1890) from the Andaman Islands in the north-eastern Indian Ocean. None of these species was well described or adequately illustrated and unfortunately Della Valle (1893) indiscriminately synonymised all of them, except *D. appendiculata*, with *D. fresnelii*. This synonymy was uncritically confirmed by Stebbing (1906) and, until Karaman & Barnard (1979), all species of *Dulichchiella* have been referred to one or the other of these two species, even though published illustrations might indicate otherwise. Ledoyer (1986) has given an excellent summary of the problems associated with available names for species of *Dulichchiella*.

Dulichchiella as a functional genus

Stout (1912) described *Dulichchiella* for *D. spinosa*, a species from southern California. The genus was established based on the misconception that the third uropods were absent, and it was therefore considered to be a dulichiid amphipod. It was never considered to be part of the melitid amphipod group until Karaman & Barnard (1979) realised that species of *Melita* with one greatly enlarged male second gnathopod belonged in Stout's *Dulichchiella* and re-established the genus. They included five species: *D. appendiculata* (Say, 1818); *D. australis* (Haswell, 1879); *D. exilii* (Müller, 1864); *D. fresnelii* (Audouin, 1826) and *D. spinosa* Stout, 1912. LeCroy (2000) redescribed *D. appendiculata* (Say, 1818) based on new material from near the type locality and 182 years after it was first described, she published the first illustrations of the species. She illustrated a second species, which she referred to as *Dulichchiella* sp. A. From LeCroy's (2000) work it was obvious that the synonymical pretence could go on no longer.

However, the original published illustrations of the type species, *Dulichchiella spinosa* Stout, 1912, are quite different from those of other species attributed to the genus. These illustrations show no setae on the anteroventral corner of the head, no accessory spines on the dactylar ungues of the pereopods, and the propodus of male gnathopod 2 does not have the distinctive distolateral crown of spines so characteristic of other

species attributed to *Dulichchiella*. Based on the published illustrations of the type species, *Dulichchiella* appeared to be a monotypic genus. However, examination of new material, collected near the type locality, indicated that Stout had missed these critical generic-level characters in her original illustrations and that she had misinterpreted the structure of the gnathopod 2 propodus.

In this paper we diagnose *Dulichchiella* based on the examination of new material of *D. spinosa* Stout, 1912. We establish several new generic level characters such as setae on the anteroventral margin of the head, accessory spines on the dactylar ungues of pereopods 3 to 7 and setose pereopods 6 and 7. We diagnose and illustrate the known species, *D. anisochir* (Krøyer, 1845), *D. appendiculata* (Say, 1818), *D. australis* (Haswell, 1879), *D. cotesi* (Giles, 1890), *D. cuvettensis* Appadoo & Myers, 2005, *D. fresnelii* (Audouin, 1826) and *D. pacifica* Lowry & Springthorpe, 2005. Based on illustrations in the published literature and new material of two species, we diagnose and describe six new species, *D. guinea* **sp. nov.**; *D. lecroyae* **sp. nov.**, *D. oahu* **sp. nov.**, *D. terminos* **sp. nov.**, *D. tomioka* **sp. nov.** and *D. tulear* **sp. nov.**

Karaman (1981) recognised that *Melita grandimana* Chevreux, 1908, was different from other species of *Melita* and moved it to *Dulichchiella*. We establish a new genus, *Verdeia*, for *Melita grandimana* Chevreux, 1908, and *Melita subchelata* Schellenberg, 1925. *Verdeia* has one massive male second gnathopod similar to that of *Dulichchiella*, but the gnathopod looks different, mainly because in *Verdeia* the angle of the palm is acute, not obtuse and the distolateral crown of spines on the propodus is absent. In addition species of *Verdeia* have no setae on the anteroventral corner of the head, no accessory spines on the dactyli of pereopods 3 to 7, pereopods 6 and 7 are not densely setose and the dorsal spines on pleonites 1 to 3 are more numerous and much smaller. We redescribe and fully illustrate *V. subchelata* (Schellenberg, 1925) and diagnose *V. grandimana* (Chevreux, 1908).

Finally, we provide a key to all species in the *Melita* group with asymmetrical male second gnathopods.

Key characters

A distinctive character apparently unique to *Dulichchiella* is the distolateral crown of spines on the propodus of the large male gnathopod 2 (fig. 1). In species like *Dulichchiella fresnelii* there are four spines in the crown. The anterior most spine (1) sits immediately adjacent to a slit in the propodus and in some species forms a shelf or may be entirely absent. The middle spines (2, 3) are always present and the posterior-most spine (4) may be well developed as in *D. fresnelii*, vestigial as in *D. appendiculata* or absent as in *D. tomioka*. Another important character of *Dulichchiella* is the number and distribution of dorsolateral spines of the pleosome and urosome. There appear to be six sets of spine formulae (Table 1):

TABLE 1. Pleosome/Urosome dorsal spine formulae for species of *Dulichchiella*.

Spine formula	Species
9-9-9-5-6-2	<i>D. anisochir</i> ; <i>D. terminos</i>
9-9-9-5-4-2	<i>D. terminos</i>
9-9-7-5-4-2	<i>D. guinea</i> ; <i>D. spinosa</i>
7-9-7-5-6-2	<i>D. tomioka</i>
7-7-7-5-6-2	<i>D. cotesi</i> ; <i>D. oahu</i> ; <i>D. pacifica</i> ; <i>D. tulear</i>
7-7-7-5-4-2	<i>D. appendiculata</i> ; <i>D. australis</i> ; <i>D. cuvettensis</i> ; <i>D. fresnelii</i> ; <i>D. lecroyae</i> ; <i>D. pacifica</i>

In several species we tested the spine formula for consistency. In *D. lecroyae* all 10 specimens examined had a consistent spine formula. In *D. appendiculata* 8 of 10 had a consistent spine formula. Two specimens deviated significantly from the pattern with a 10-11-7-5-4-2 or a 10-9-7-5-4-2 formula. In *D. pacifica* the formula was consistent for all ten specimens except there were either 4 or 6 spines on urosomite 2. Overall the spine formulae appear to be consistent within species.

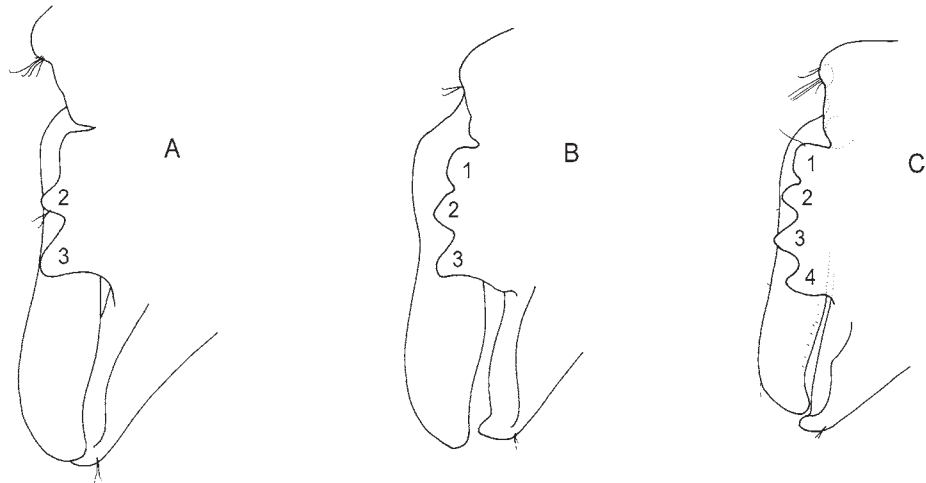


FIGURE 1. Enlarged male gnathopod 2 showing the variation in the number of distolateral crown spines. (A) 2 spines, (B) 3 spines, (C) 4 spines

In addition to the sexually dimorphic gnathopods *Dulichella* exhibits sexual dimorphism in pereopods 6 and 7. In species of *Dulichella* the basis of pereopod 7 in males is usually only partially expanded, but in adult females the basis of pereopod 7 is fully expanded. Pereopod 6 and 7 have sparse setation along the margins of the articles in females, but adult males usually have large bunches of long, slender setae on pereopods 6 and 7. There appear to be three states: bunches on the basis, merus, carpus and propodus; bunches on the carpus and propodus; or no bunches (fig. 2).

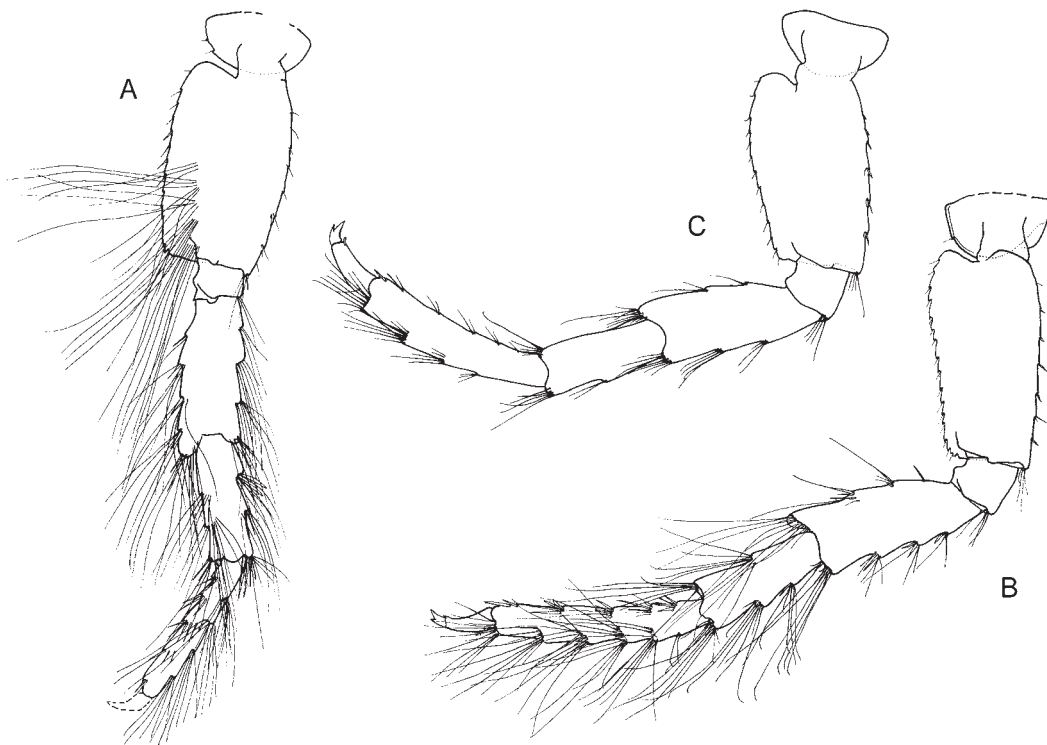


FIGURE 2. Male pereopod 7 showing variation in bunches of slender setae (A) on basis, merus, carpus and propodus, (B) on carpus and propodus, (C) absent.

The enlarged male gnathopod 2

Species of *Dulichchiella* live in tropical and warm temperate seas around the world. They are epibenthic amphipods, often associated with algae, ascidians, bryozoans and sponges. They regularly occur in high numbers on artificial substrates. They are probably herbivores. According to Duffy & Hay (2000), *Dulichchiella appendiculata* is a mesograzer on brown algae such as *Sargassum*.

The enormously enlarged and spectacular male gnathopod 2 represents a huge energy investment for species in the genus and presumably plays an important role in their life histories. There is very little discussion in the literature about the possible function of this gnathopod. Walker (1904) thought “from its resemblance to a bit of broken shell, that its use is protective, the animal covering itself with it as it lies partly buried in the sand. Dr. Herdman informs me that he has seen them in this position.” Jarrett & Bousfield (1996) suggested that it might produce sound.

A number of recent field and laboratory observations may allude to the role of this impressive structure. In the field, aggregational behaviour has been observed for two species of *Dulichchiella*, *D. australis* and *D. pacifica*, at several locations by two independent researchers. Aggregations of 500 to 1,000 individuals have been recorded on small artificial substrates for *D. australis* at Solitary Island, Coffs Harbour and at Bare Island, Botany Bay, Australia (Lauren Hughes, pers. comm.) and for *D. pacifica* on settlement plates at a fish farm in Singapore (Catherine Lee, pers. comm). In the laboratory, males have been observed producing a loud snapping sound using the enlarged gnathopod 2, and could be prompted to produce this sound when stimulated by agitation with a probe (Jim Thomas, pers. comm.).

Based on these observations the enlarged second gnathopod in male *Dulichchiella* could be utilised in reproductive behaviour to attract conspecifics and/or in a defensive response. A recent paper by Toth & Duffy (2005) on alpheid snapping shrimp described coordinated snapping among a colony of *Synalpheus* species to repel intruders. *Dulichchiella*, with its similar snapping appendage, may display a similar behaviour, however, further laboratory observation is required to understand the functional role of the enlarged male gnathopod two.

Materials and methods

The taxonomic descriptions were generated from a DELTA (Dallwitz, 2005) database of world melitid genera and species. Only males are diagnosed. The male of each *Dulichchiella* species is diagnosed against the males of every other species in the genus. Characters in bold type are diagnostic. In keys and descriptions, the terminology describing gnathopodal palms is as follows: a palm that is close to perpendicular to the longitudinal axis of the propodus is referred to as transverse; a palm in which the angle is less than 90° is referred to as acute; and a palm in which the angle is more than 90° is referred to as obtuse (see Poore & Lowry, 1997). Materials used or referred to in this study are lodged in the Amakusa Marine Biological Laboratory, Amakusa, Kyushu (AMBL), the Australian Museum, Sydney (AM), the Musée Océanographique, Monaco (MOM), the Museo Civico di Storia Naturale, Verona (MCSN), the Muséum National d'Histoire Naturelle, Paris (MNHN), the Los Angeles County Museum of Natural History (LACMNH), the Museum für Naturkunde, Berlin, (ZMB), the National Museum of Natural History, Washington DC (USNM), the National Museum of Scotland, Edinburgh (NMS), the Naturhistorisches Museum, Vienna (MHMW), the South African Museum, Cape Town (SAM), the Southeastern Regional Taxonomic Center, Charleston, South Carolina (SERTC) and the Zoological Museum, Copenhagen, (ZMUC). The following abbreviations are used on the plates: **A**, antenna; **C**, coxa; **EP**, epimeron; **G**, gnathopod; **H**, head; **MD**, mandible; **MP**, maxilliped; **MX**, maxilla; **p**, palp; **P**, pereopod; **PLN**, pleonite; **T**, telson; **U**, uropod; **UR**, urosomite; **L**, left; **R**, right.

Taxonomy

Melitidae Bousfield, 1973

Key to species (males) of *Dulichieilla* and *Verdeia*

1. Pereopods 3–7 dactylar unguis without accessory spines on anterior margin (fig. 44) (*Verdeia* **gen. nov.**) 2
 - Pereopods 3–7 dactylar unguis with accessory spines on anterior margin (fig. 9) (*Dulichieilla*) 3
2. Pereopod 5 basis broadly expanded, with rounded posterior margin (fig. 40) *Verdeia grandimana*
 - Pereopod 5 basis slightly expanded, with straight posterior margin (fig. 44) *Verdeia subchelata*
3. Gnathopod 2 propodus distolateral crown with 2 spines (fig. 38) 4
 - Gnathopod 2 propodus distolateral crown with 3 spines (fig. 5) 5
 - Gnathopod 2 propodus distolateral crown with 4 spines (fig. 21) 10
4. Antenna 1 peduncular article 1 with 4 robust setae along posterior margin (fig. 14). Pereopods 3–7 dactylar unguis with 1 accessory spine (fig. 15). Epimeron 3 with smooth posterior margin (fig. 14) *Dulichieilla cotesi*
 - Antenna 1 peduncular article 1 with 3 robust setae along posterior margin (fig. 37). Pereopods 3–7 dactylar unguis with 2 accessory spines (fig. 38). Epimeron 3 with minutely serrate posterior margin (fig. 37) *Dulichieilla tomioka* **sp. nov.**
5. Epimeron 3 posterior margin serrate distally (fig. 4) 6
 - Epimeron 3 posterior margin smooth (fig. 10) 7
6. Gnathopod 1 coxa anteroventral margin produced, anterior margin concave (fig. 4) *Dulichieilla anisochir*
 - Gnathopod 1 coxa anteroventral margin not produced, anterior margin straight or slightly convex (fig. 39) *Dulichieilla tulear* **sp. nov.**
7. Gnathopod 2 propodus distolateral crown with acute spines (fig. 36) *Dulichieilla terminos* **sp. nov.**
 - Gnathopod 2 propodus distolateral crown with rounded spines (fig. 39) 8
8. Pereopods 3–7 dactylar unguis with one accessory spine on anterior margin (fig. 12) 9
 - Pereopods 3–7 dactylar unguis with two accessory spines on anterior margin (fig. 29) *Dulichieilla oahu* **sp. nov.**
9. Pleonites 1–2 each with 7 dorsal spines (fig. 12). Pereopods 6–7 merus to propodus with bunches of long slender setae (fig. 12) *Dulichieilla australis*
 - Pleonites 1–2 each with 9 dorsal spines (fig. 33). Pereopods 6–7 merus to propodus without bunches of long slender setae (fig. 35) *Dulichieilla spinosa*
10. Pleonites 1–3 with sparse dorsal setae (fig. 20) 11
 - Pleonites 1–3 with dense dorsal setae (fig. 23) *Dulichieilla guinea* **sp. nov.**
11. Pereopods 3–7 dactylar unguis with two accessory spines on anterior margin (fig. 17) 12
 - Pereopods 3–7 dactylar unguis with one accessory spines on anterior margin (fig. 22) 13
12. Pereopods 6–7 basis, merus to propodus with bunches of long slender setae (fig. 10) *Dulichieilla appendiculata*
 - Pereopods 6–7 without bunches of long slender setae on basis and merus, distal articles not known (fig. 18) *Dulichieilla cuvettensis*
13. Head with apically truncated lateral cephalic lobe (fig. 20) 14
 - Head with apically rounded lateral cephalic lobe (fig. 26) *Dulichieilla lecroyae* **sp. nov.**
14. Pereopod 6 basis posterior margin straight (straight in female) (fig. 22) *Dulichieilla fresnelii*
 - Pereopod 6 basis posterior margin concave (strongly subsigmoid in female) (fig. 31) *Dulichieilla pacifica*

***Dulichhiella* Stout, 1912**

Dulichhiella Stout, 1912: 140. —Karaman & Barnard, 1979: 152. —Karaman, 1981: 39. —Barnard & Barnard, 1983: 667. —Jarrett & Bousfield, 1996: 13.

Type species. *Dulichhiella spinosa* Stout, 1912, monotypy.

Diagnosis. Head anteroventral corner with several long, slender setae. Antenna 1 longer than antenna 2. Maxilla 1 inner plate long, narrow, tapering distally, with 2 well developed apical plumose setae. Maxilla 2 inner plate with oblique setal row. Gnathopod 2 male, asymmetrical, significantly unequal in size; palm in larger slightly obtuse; those of female equal in size. Pereopods 5–7 distal articles strongly to weakly setose; dactylar ungues with accessory spines. Pereopods 6 and 7 in males with bunches of long slender setae. Pereopod 7 basis in female fully expanded. Pleonites dorsally serrate. Uropod 3 inner ramus scale-like; outer ramus 4 to 5 x longer than wide, 2-articulate. Telson deeply cleft, lobes tapering distally to an acute point.

Included species. *Dulichhiella* includes 14 species: *D. anisochir* (Krøyer, 1845); *D. appendiculata* (Say, 1818); *D. australis* (Haswell, 1879); *D. cotesi* (Giles, 1890); *D. cuvettensis* Appadoo & Myers, 2005; *D. fresnelii* (Audouin, 1826); *D. guinea* **sp. nov.**; *D. lecroyae* **sp. nov.**; *D. oahu* **sp. nov.**; *D. pacifica* Lowry & Springthorpe, 2005; *D. spinosa* Stout, 1912; *D. terminos* **sp. nov.**; *D. tomioka* **sp. nov.**; *D. tulear* **sp. nov.**

Records of *Dulichhiella* not attributable to any species. Some reports of *Dulichhiella* cannot be placed with any current species, usually because they are not illustrated or poorly illustrated and are from an area where no species have been described. These include the following:

Melita exilii Müller, 1864: 6, fig. In the text of Müller (1864) there are no diagnostic characters to distinguish *D. exilii* and no mention is made of type material or type locality. The text figure definitely shows a species of *Dulichhiella*, but the illustration is too general to distinguish it as a particular species. *Dulichhiella exilii* is considered to be an unidentifiable species.

Melita anisochir. —Walker, 1904: 270, pl. 4, fig. 28 (Sri Lanka). Walker only illustrated a female and referred to Giles (1890) illustrations of the male of *D. cotesi*. We have seen Walker's (1904) material. There are two microscope slides (363 and 364) which have deteriorated to the point where they are no longer useful for precise identification or illustration. However, the distolateral crown of male gnathopod 2 has four spines, which indicates that it is not *D. anisochir*. There are no dense dorsal setae on the pleon which indicates that it is not *D. guinea*. There appears to be only one accessory spine on the pereopodal dactyli, which puts it in a group with *D. lecroyae*, *D. fresnelii* and *D. pacifica*, but it is not possible to see the characters which distinguish these species.

Melita appendiculata. —Griffiths, 1973: 286 (Morrumbene Estuary and Inhaca Island, Mocambique). —Griffiths, 1974a: 191 (South-west Africa — now Namibia). —Griffiths, 1974b: 237 (Natal; Durban Bay, South Africa). —Griffiths, 1976: 46, fig. 22a (illustration of *D. oahu* after J.L. Barnard, 1970). None of this material was illustrated and cannot be identified. We have tried to borrow Griffiths' (1973, 1974a, b) material from the South Africa Museum, but unfortunately it is very difficult to borrow these collections for study.

Dulichhiella appendiculata. —Jarrett & Bousfield, 1996: 13, figs 5, 6. The diagnosis is apparently not based on any material, but may be a composite based J.L. Barnard (1971) (*D. appendiculata* [= *D. oahu* **sp. nov.**] from Hawaii) and Hirayama & Kikuchi (1979) (*D. appendiculata* [= *D. tomioka* **sp. nov.**] from Japan). The figures are modified from those presented in these two publications. The British Columbian record of this species seems to be based on a questionable literature record of *Melita appendiculata* listed by Austin (1985) (Jarrett & Bousfield, 1996).

Dulichhiella appendiculata. —Ortiz & Lalana, 1997: 109. This record from Bontang, Indonesia appears in a checklist to the species of the area with no description and no illustrations.

Melita fresnelii. —Walker, 1909: 334 (Amirante; Cargados Carajos; Wasin; Suakim Harbour). —K.H. Barnard, 1916: 189, pl. 28, fig. 32 (Morewood Cove and Umholti River, Natal; off Durban, South Africa). —

Shoemaker, 1935: 239 (Julia Cove, Guanica Harbour, Puerto Rico). —Pirlot, 1936: 304 (Paternoster Islands; Badjo Bay, Flores; Makassar; Borneo Bank; Ternate; Damar Island; Ambon; Banda; Aru; Saleh Bay). —K.H. Barnard, 1937: 159 (Red Sea; Gulf of Aden; Zanzibar). —Rudwick, 1951: 149 (Gulf of Aden). —Nayar, 1959: 22, pl. 7, figs 1—5 (as *M. fresnalii*, Madras, eastern India). —Nayar, 1966: 148, fig. 5f. —Sivaprakasam, 1968: 111 (Pamban and Tondi-Nambuthalai, eastern India). Of all these records, only K.H. Barnard (1916) and Nayar (1959) attempted to illustrate their specimens, but not well enough to allow identification.

Gammarus (Maera) valida Dana, 1852: 966, pl. 66, figs 6a–c. (Singapore). The illustration shows two distolateral spines on the male gnathopod 2. Only two species have this arrangement, *D. cotesi* and *D. tomioka*. Both species are in the right geographic area, but Dana's illustrations are inadequate to make a positive identification.

Remarks. *Dulichchiella* appears to be most similar to *Abludomelita* Karaman, 1981 and *Verdeia* **gen. nov.** It is similar to *Abludomelita* in the dorsal spination of the pleosome/urosome, but in *Abludomelita* the male second gnathopods are symmetrical and not so enormously enlarged. *Dulichchiella* and *Verdeia* both have asymmetrical gnathopods, with one enormously enlarged, but the shapes of the palm are different and the dorsal spination of the pleosome/urosome is very weak in *Verdeia*. *Dulichchiella* differs from both of these genera (*Abludomelita* and *Verdeia*) in having a tuft of slender setae on the anteroventral corner of the head, a well developed distolateral crown on the enlarged male gnathopod 2 propodus, accessory spines on the dactylar unguis of pereopods 3 to 7 and long, slender setae on the male pereopods 5 to 7.

Sexually dimorphic characters for *Dulichchiella* include the asymmetrical, massively enlarged, male gnathopod 2; the shape of the palm of gnathopod 2 in the female; bunches of long, slender setae on pereopods 6 and 7 of the male; and the expansion of the female pereopod 7 basis.

***Dulichchiella anisochir* (Krøyer, 1845)**

(Figs 3–6)

Melita anisochir Krøyer, 1845: 317, pl. II, fig. 1a–p. —Dana, 1852: 968, pl. 66, fig. 8a–d. —Ledoyer, 1986: 185.

Melita fresnelii. —Della Valle, 1893: 708 (in part), pl. 60, fig. 6. —Stebbing, 1906: 423 (in part).

? *Gammarus (Maera) setipes* Dana, 1852: 212, 213.

? *Gammarus (Maera) pilosus* Dana, 1852: 212, 213.

? *Dulichchiella appendiculata*. —Wakabara, *et al.*, 1991: 73. —Wakabara & Serejo, 1998: 574. —Serejo, 1998: 373.

Type material. Lectotype male, 10.7 mm, ZMUC CRU 3717 Rio de Janeiro, Brazil. Paralectotypes: 1 female, 11.8 mm, ZMUC CRU 9895; many specimens, ZMUC CRU 9896; 32 specimens (14 males, 18 females), ZMUC CRU 5339; 8 specimens (4 males, 4 females), AM P69546, same locality.

Type locality. Rio de Janeiro, Brazil.

Additional material examined. 1 male, 1 female MNRJ 14035, off Lagoa dos Patos, southern Brazil (32°25'00"S 51°35'00"W), 33 m, 4 December 1992, stn 528. 2 males, MNRJ 4636, Cabo Frio Island, Arraial do Cabo, Rio de Janeiro, Brazil, 16 Dec 1969. 2 males, MNRJ 7699, on signalization buoy, Coroa de Pedra, off Itaparica Island, Bahia, Brazil, P. Young & M.C. Brito, 3 Feb 1993. 2 males, MNRJ 10388, Massambaba Beach, Arraial do Cabo, Rio de Janeiro, Brazil, #III, 60 m, Aviso Pesqueiro Suboficial Oliveira, 21 June 1988. 1 male, 2 females, MRJ 15963, Project Revizee Central 2, #23C (20°29'00"S 36°06'00"W), soft bottom, dredge, 60 m, RV *Astrogaroupa*, 8 November 1997. 2 males, 2 females, MNRJ 15965, Project Revizee Central 2, #34C (26°46'02"S 40°05'59"W), soft bottom, dredge, 55 m, RV *Astrogaroupa*, 3 November 1997. 1 male, MNRJ 10400, off Itapemirim, Espírito Santo, Brazil (21°18'58"S 40°28'63"), F.B. Pitombo.

Description. Based on lectotype male, 10.7 mm, ZMUC CRU 3717. Body large. Head eyes ovate; lateral cephalic lobe broad, truncated, anteroventral corner with slender seta. Antenna 1 peduncular article 1 shorter

than article 2, with 3 robust setae along posterior margin. Antenna 2 peduncular article 2 cone gland not reaching to end of peduncular article 3; article 4 longer than article 5. Mandibular palp article 1 about as long as broad, inner margin article 1 produced distally; article 2 slightly shorter than article 3.

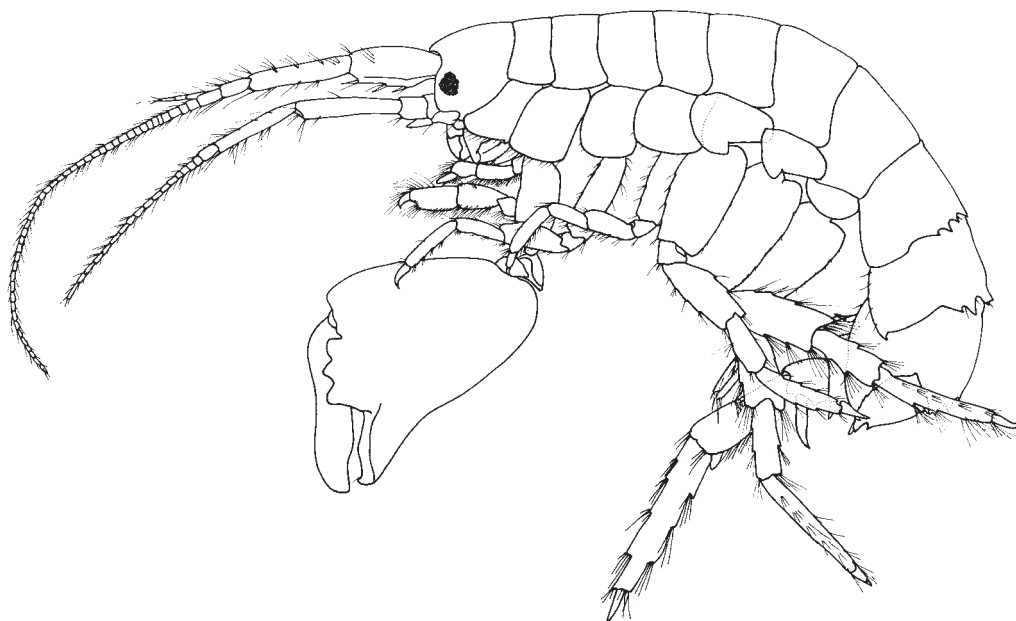


FIGURE 3. *Dulichiella anisochir* (Krøyer, 1845), lectotype male, 10.7 mm, ZMUC CRU 3717, Rio de Janeiro, Brazil.

Gnathopod 1 coxa anteroventral corner produced, rounded, anterior margin concave, posteroventral corner notch present; carpus subequal in length to propodus; propodus "stout", palm convex, defined by posterodistal corner, **without posterodistal robust setae**. **Gnathopod 2** coxa posteroventral corner notch present; (larger) **propodus distolateral crown with 3 rounded indistinct spines**, palm sinusoidal, posterodistal corner produced, upturned, **posterodistal corner with dactylus overlapping corner**; dactylus apically blunt; (smaller) merus with sharp posteroventral spine; palm straight, without robust setae, posterodistal corner with robust setae; dactylus with 4 setae on anterior margin. Pereopod 5 dactylar unguis anterior margin with accessory spine. Pereopods 6–7 basis, merus, carpus and propodus without bunches of long slender setae. Pereopod 6 basis posterior margin straight; dactylar unguis anterior margin with accessory spine. **Pereopod 7 basis posterior margin slightly subsigmoid**, tapering distally.

Pleonite/urosomite dorsal spine formula (9-9-9-5-6-2). Pleonites 1–3 with dorsal setae. Epimeron 1 posteroventral corner with small acute or subacute spine. Epimeron 2 posteroventral corner acute. Epimeron 3 posteroventral margin minutely serrate distally. Urosomite 1 with three dorsal spines. Urosomite 2 with two groups of 1–3 small dorsolateral robust setae. Urosomite 3 without dorsal setae, with 2 dorsal spines. Uropod 3 outer ramus very long, length about 2 x peduncle. Telson with dorsal robust setae.

Female (sexually dimorphic characters). Gnathopod 2 subequal in size, similar to smaller gnathopod 2 of male; palm straight; dactylus posterior margin crenulate. Pereopod 7 basis expanded, posterior margin slightly convex, tapering distally.

Habitat. Marine epibenthic, 0–30 m depth.

Remarks. There are two lots in the Zoological Museum, Copenhagen which contain material of *D. anisochir* from Rio de Janeiro, both collected at the same time, same location and by the same collector. One lot is labelled as syntypes and the other one is not. We are treating all of this material as syntypes (in agreement with Jørgen Olesen, Curator of Crustacea, ZMUC).

Dulichiella anisochir has been in synonymy since Della Valle (1893). It shares with four other species (*D. australis*, *D. oahu*, *D. spinosa* and *D. tulear*) three spines on the distolateral crown of male gnathopod 2. It

appears to differ from all of those species in having a well produced anterodistal process on the coxa of gnathopod 1 and in having a restricted dorsal spine formula (9-9-9-5-6-2).

Distribution. Brazil. Rio de Janeiro to Lagoa dos Patos.

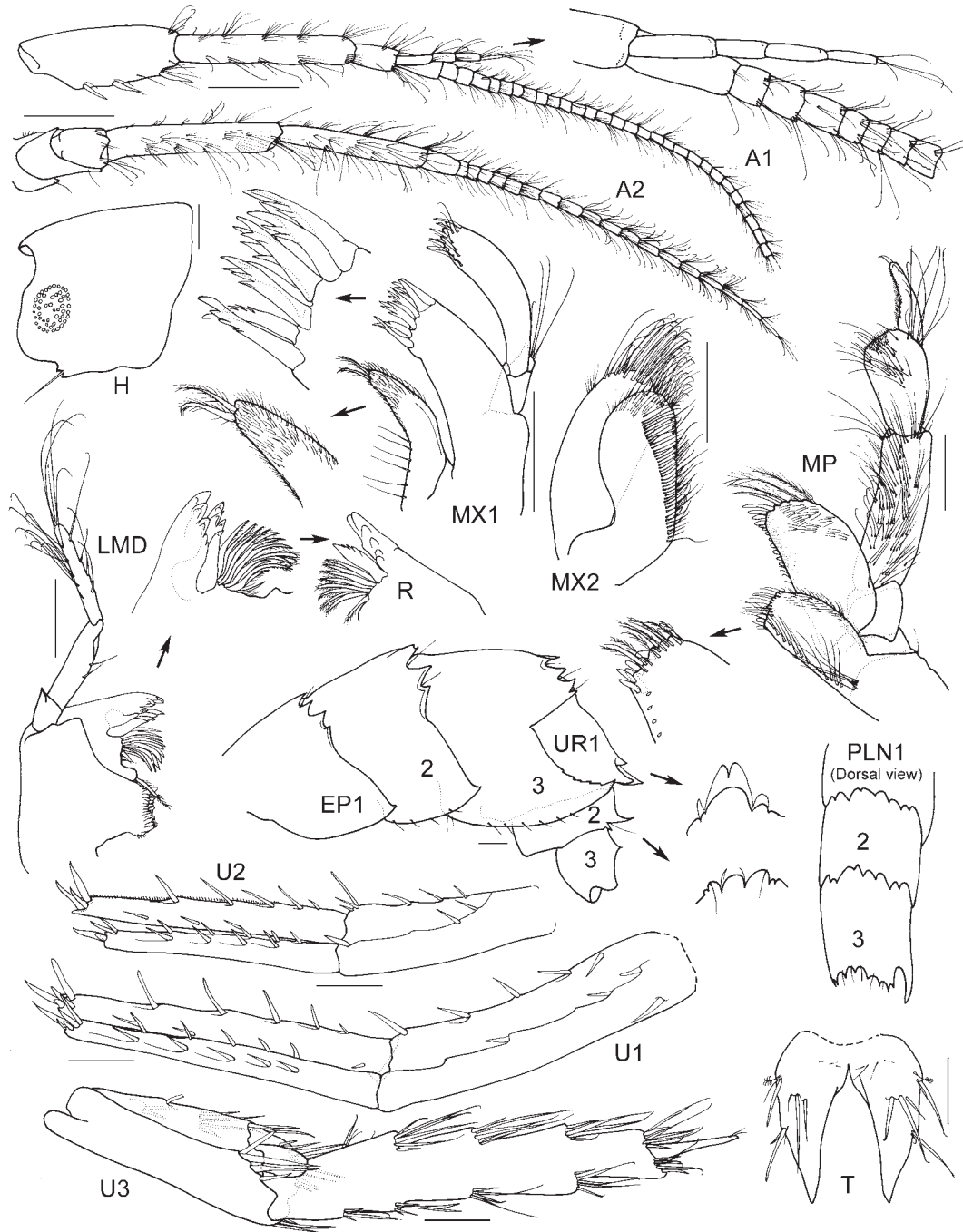


FIGURE 4. *Dulichiella anisochir* (Krøyer, 1845), lectotype male, 10.7 mm, ZMUC CRU 3717, Rio de Janeiro, Brazil. U3 from unknown specimen. Scales represent 0.2 mm.

***Dulichiella appendiculata* (Say, 1818)**

(Figs 7–10)

Gammarus appendiculatus Say, 1818: 377. –Bate, 1862: 223. –Della Valle, 1893: 765.

Melita appendiculata. –Stebbing, 1906: 428 (in part). –Feeley & Wass, 1971: 17. –Wass, 1972: 149. –Watling & Maurer,

1972: 262, tpls 5, 6. –Marsh, 1973: 90, tbl 1. –Ortiz, 1979a: 11. –Ortiz, 1979b: 15. –Sheridan, 1979: 70.
Melita dentata. –Pearse, 1912: 371 (according to Shoemaker, 1955 and LeCroy, 2000).
Melita fresneli. –Wass, 1965: 36.
Dulichchiella appendiculata. –Karaman & Barnard, 1979: 153. –Barnard & Barnard, 1983: 668. –Ortiz & Lalana, 1993: 23. –LeCroy, 2000: 77, fig. 125.
Not *Melita appendiculata*. –J.L. Barnard, 1970: 161, figs 101–102 (= *D. oahu* **sp. nov.**). –J.L. Barnard, 1971: 85 (= *D. oahu* **sp. nov.**). –Hirayama & Kikuchi, 1979: 69, figs 2–6 (= *D. tomioka* **sp. nov.**). –Ischimarū, 1994: 49 (= *D. tomioka* **sp. nov.**).
Not *Dulichchiella appendiculata*. –Ledoyer, 1979: 570, fig. 216 (= *D. tulear* **sp. nov.**). –Ledoyer, 1986: 185, fig. 8 (= *D. terminos* **sp. nov.**). –Ledoyer, 1986: 187, fig. 9 Mau (= *D. cuvetensis* Appadoo & Myers, 2005), fig. 9 S (= *D. guinea* **sp. nov.**). –Berents, 1983: 111, fig. 9 (= *D. pacifica* Lowry & Springthorpe, 2005). –Hirayama, 1986: 35, fig. 220 (map) (= *D. tomioka* **sp. nov.**). –Ischimarū, 1994: 49 (= *D. tomioka* **sp. nov.**). –Wakabara & Serejo, 1998: 574 (= ?*D. anisochir* (Krøyer, 1845)).

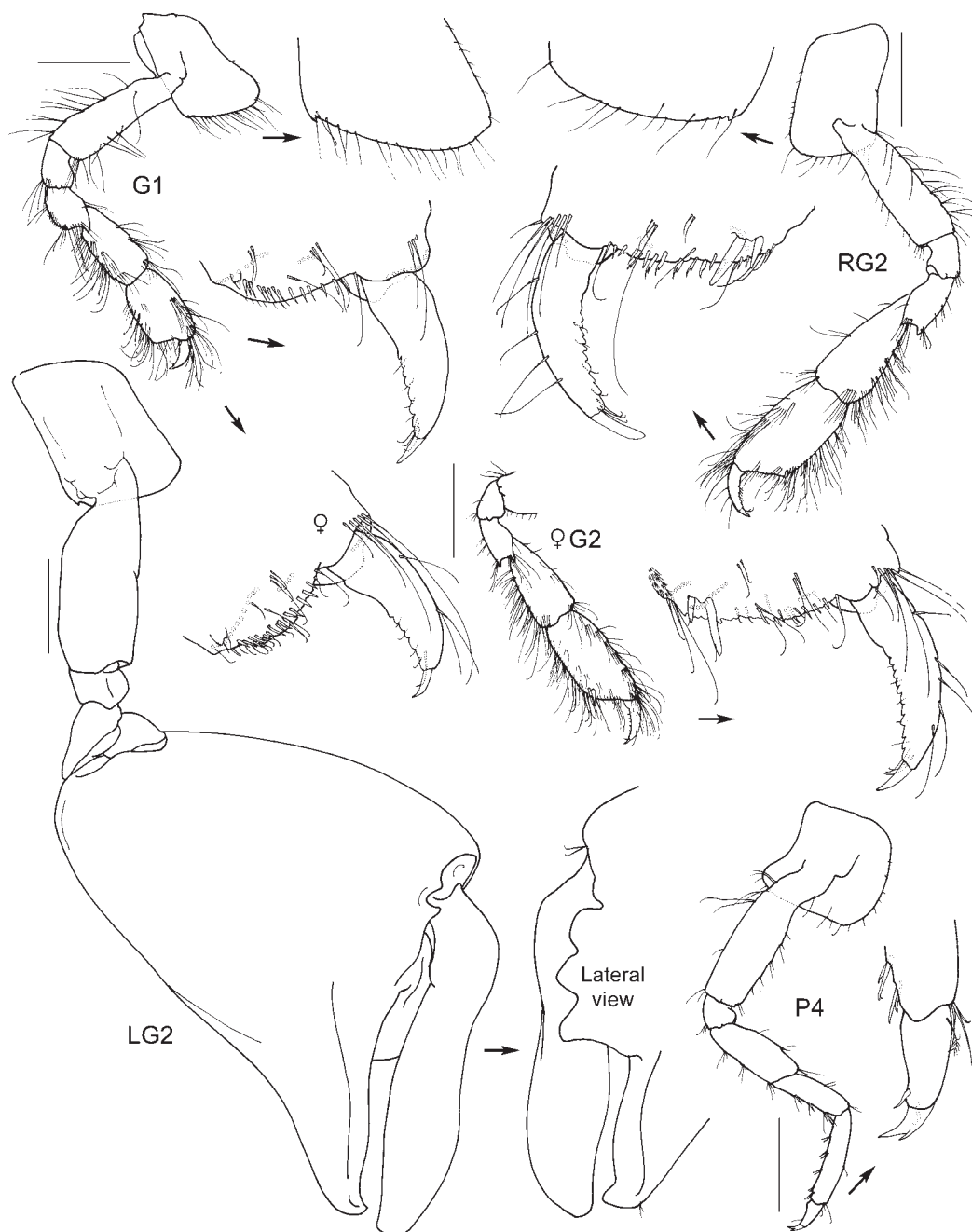


FIGURE 5. *Dulichchiella anisochir* (Krøyer, 1845), lectotype male, 10.7 mm, ZMUC CRU 3717, paralectotype female 11.8 mm, ZMUC CRU 9895, Rio de Janeiro, Brazil. Scales represent 0.5 mm.

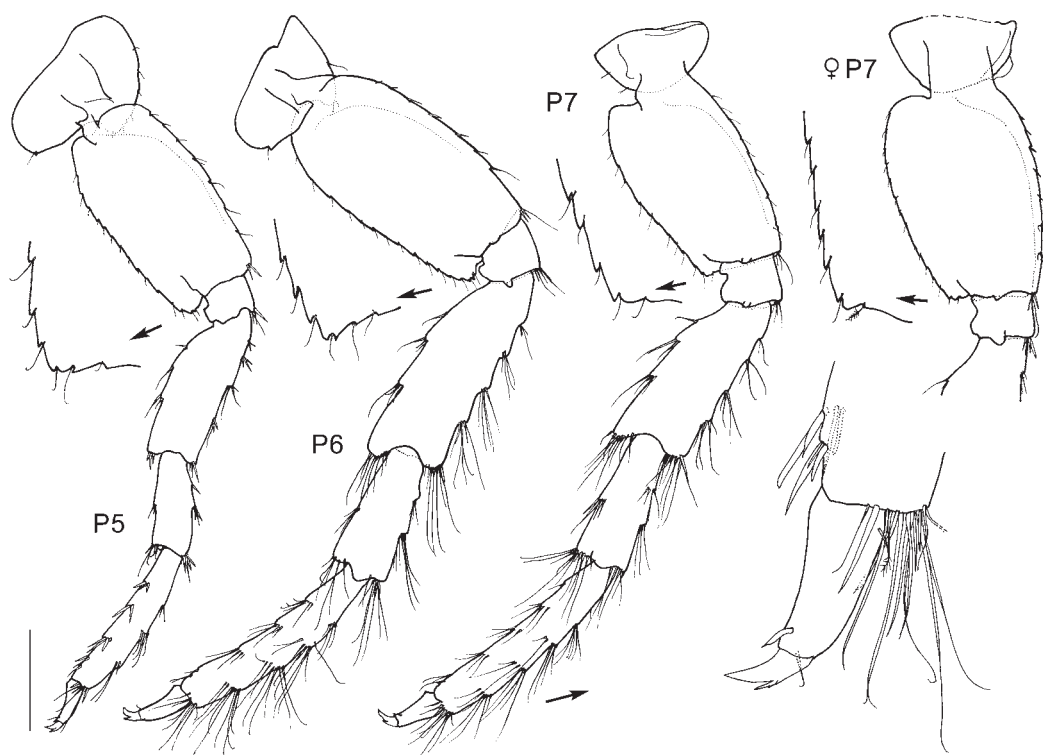


FIGURE 6. *Dulichiella anisochir* (Krøyer, 1845), lectotype male, 10.7 mm, ZMUC CRU 3717, paralectotype female 11.8 mm, ZMUC CRU 9895, Rio de Janeiro, Brazil. Scales represent 0.5 mm.

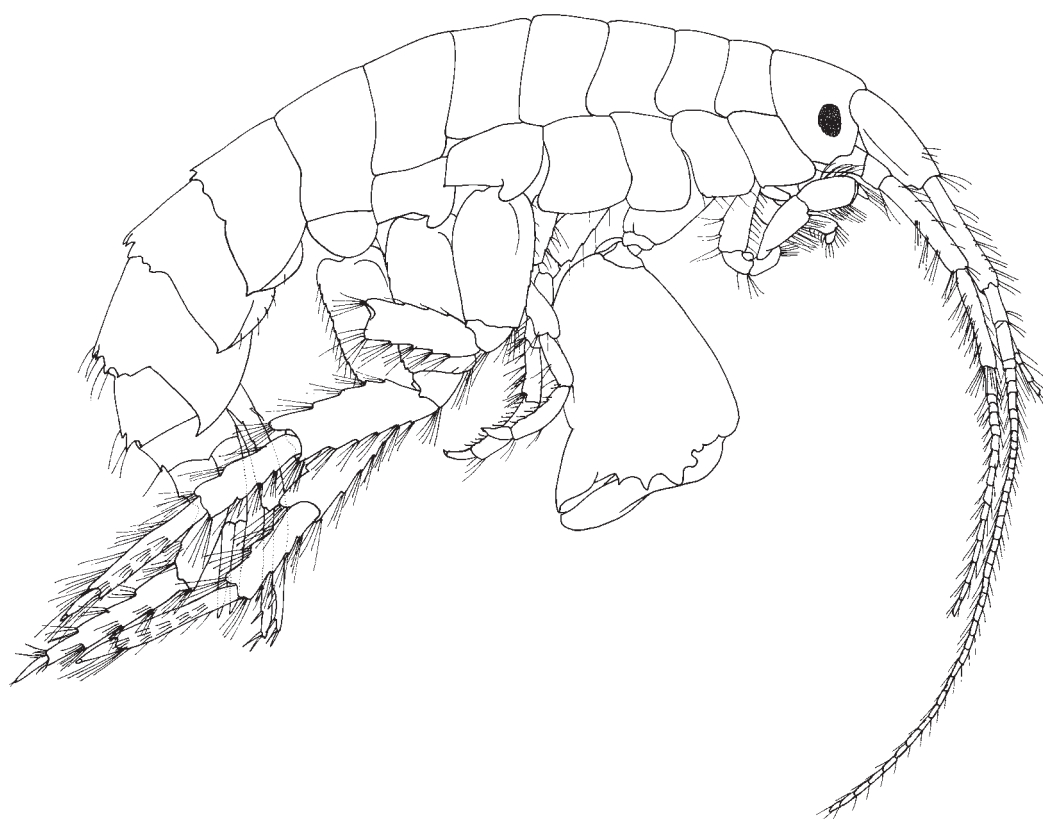


FIGURE 7. *Dulichiella appendiculata* (Say, 1818), neotype male, 8.1 mm, USNM 1092318, McQueen Inlet, Saint Catherines Island, Georgia, USA.

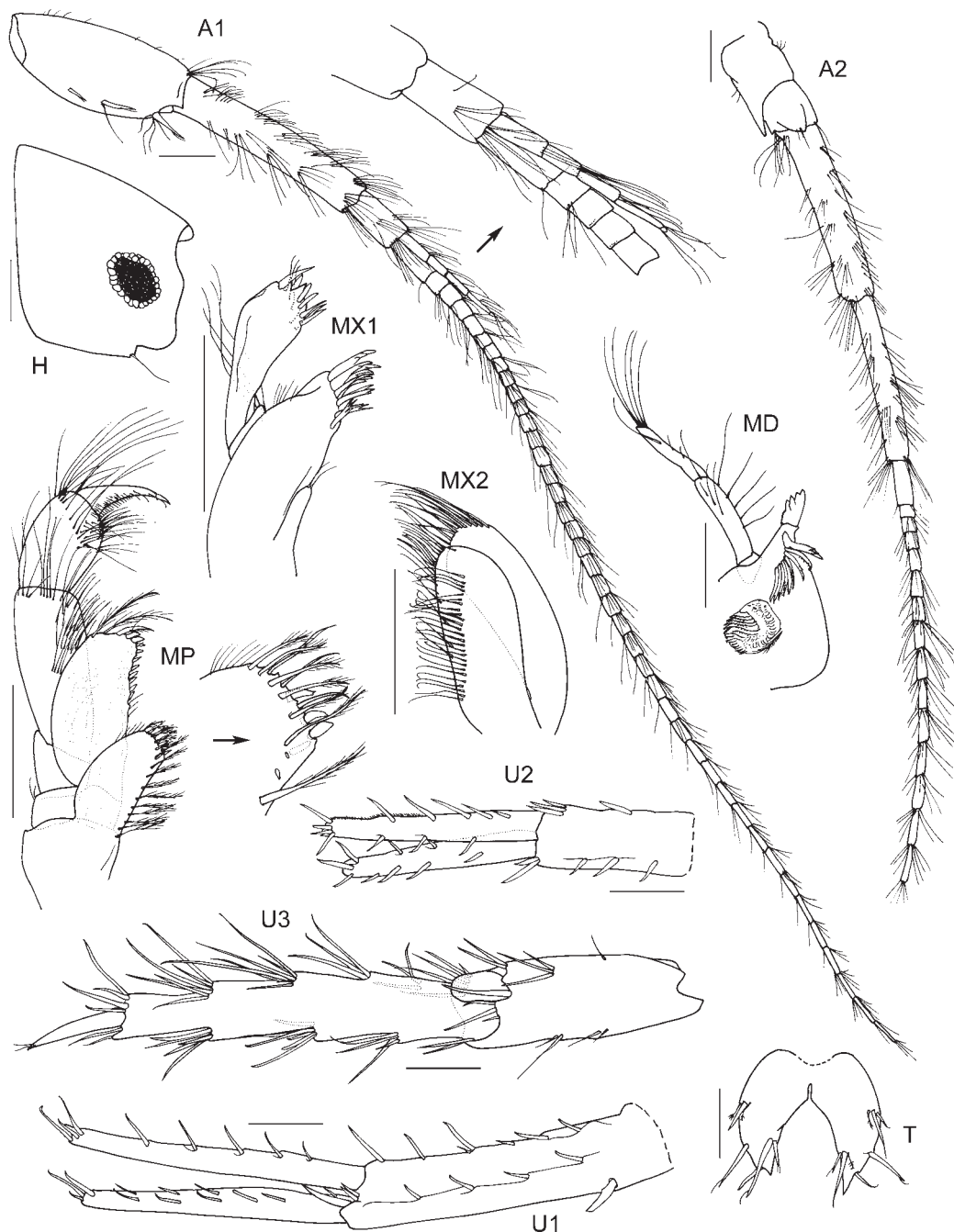


FIGURE 8. *Dulichiella appendiculata* (Say, 1818), neotype male, 8.1 mm, USNM 1092318, McQueen Inlet, Saint Catherines Island, Georgia, USA. Scales for MX1 and MX2 represent 0.1 mm, remainder represent 0.2 mm.

Type material. Neotype male, 8.1 mm, USNM 1092318, McQueen Inlet, Saint Catherines Island, Georgia, USA (31°38'06"N 81°08'06"W), R.W. Heard, 18 February 1991.

Type locality. McQueen Inlet, Saint Catherines Island, Georgia, USA (31°38'06"N 81°08'06"W).

Additional material. Georgia: 1 female (ovigerous), 6.7 mm, USNM 1092319, 42 specimens, USNM 1092320. 40 specimens, AM P61182, McQueen Inlet, Saint Catherines Island, Georgia, USA, 31°38'06"N 81°08'06"W, R.W. Heard, 18 February 1991.

Florida: Specimens, Indian River Lagoon, St. Lucie County (27°26.30' N, 80°18.00'W), USNM acc. # 318210, buoy 191, grass bed, Harbor Branch Indian River Survey, stn 41R. Specimens, Pigeon Key, USNM acc # 162578, USFCS *Fish Hawk*, 20 December 1912. Specimens, Battlepoint Key, Florida Bay, USNM acc.

157628, (B.P.T.S. #4), wharf piling, R.P. Allen, 20 November 1939. 1 ovigerous female, Bonita Beach, USNM Acc. # 161453. 25–30 specimens, Lemon Bay, USNM acc. # 146660, Olga Hartman, January 1938. Bird Key, Sarasota Bay, USNM Acc. # 167697, M.W. Williams, 8 May 1944. Adult female, Tampa Bay, USNM #64746, USFCS *Albatross*, 17 March 1885. Alligator Harbor, about 40 miles south of Tallahassee, USNM acc. # 185296, from seaweed growing on bottom, about 1m depth, H.J. Humm, 22 October 1949. 2 specimens (adult female, adult male) Crooked Island Sound, St. Joe, USNM acc. # 136942; eelgrass; A.S. Pearse, 21 November 1935.

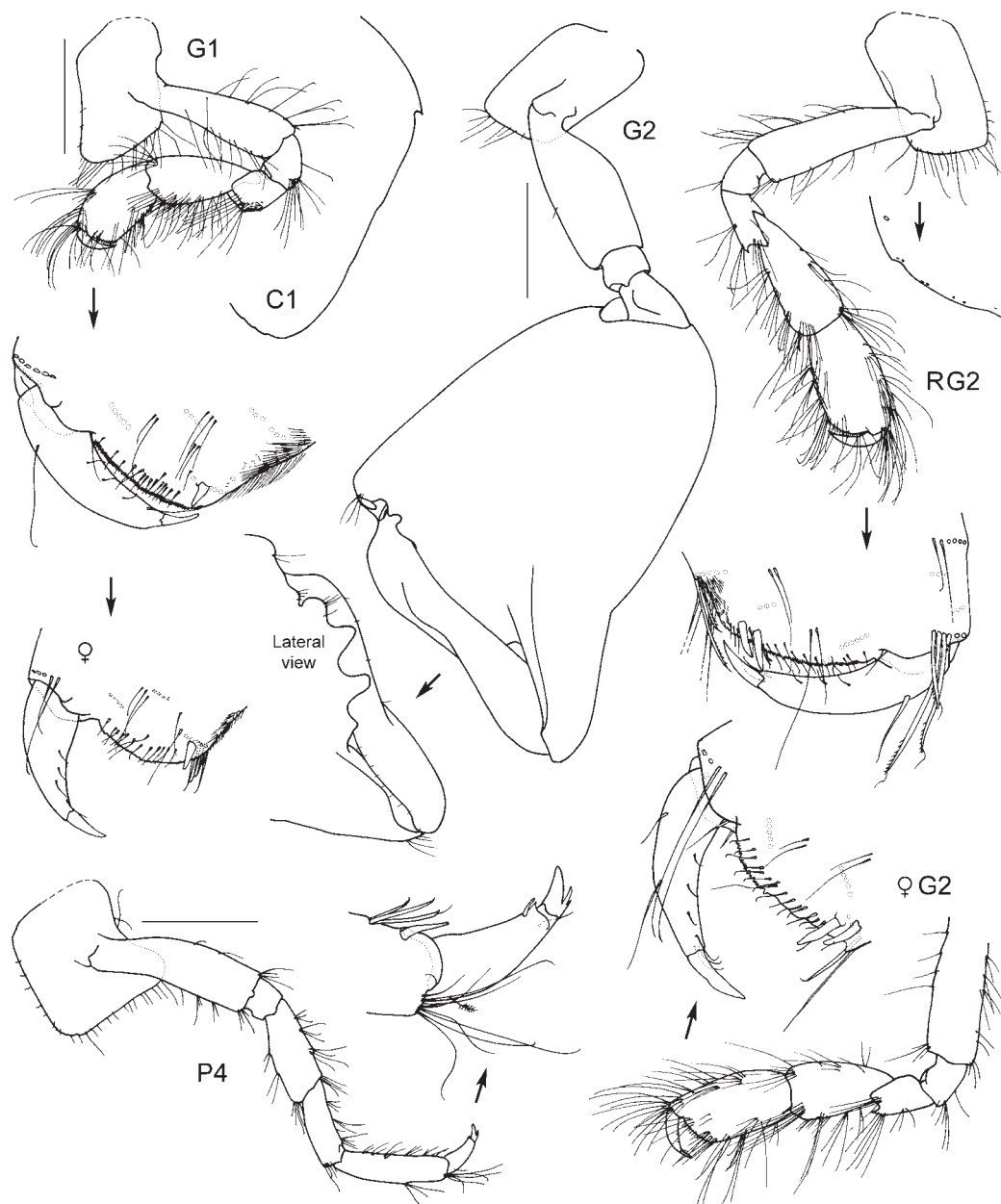


FIGURE 9. *Dulichiella appendiculata* (Say, 1818), neotype male, 8.1 mm, USNM 1092318, female, 6.7 mm, USNM 1092319, McQueen Inlet, Saint Catherines Island, Georgia, USA. Scales represent 0.5 mm.

Louisiana: Cameron, USNM 33120, L.R. Cary (identified by Pearse, 1912 as *Melita dentata*).

Description. Based on neotype male, 8.1 mm, USNM 1092318, and female (ovigerous), 6.7 mm, USNM 1092319. Body large. Head eyes ovate; lateral cephalic lobe broad, truncated, anteroventral corner with slender seta. Antenna 1 peduncular article 1 shorter than article 2, with 3 robust setae along posterior margin.

Antenna 2 peduncular article 2 cone gland reaching at least to end of peduncular article 3; article 4 slightly longer than article 5. Mandibular palp article 1 about as long as broad, inner margin article 1 not produced distally; article 2 slightly longer than article 3.

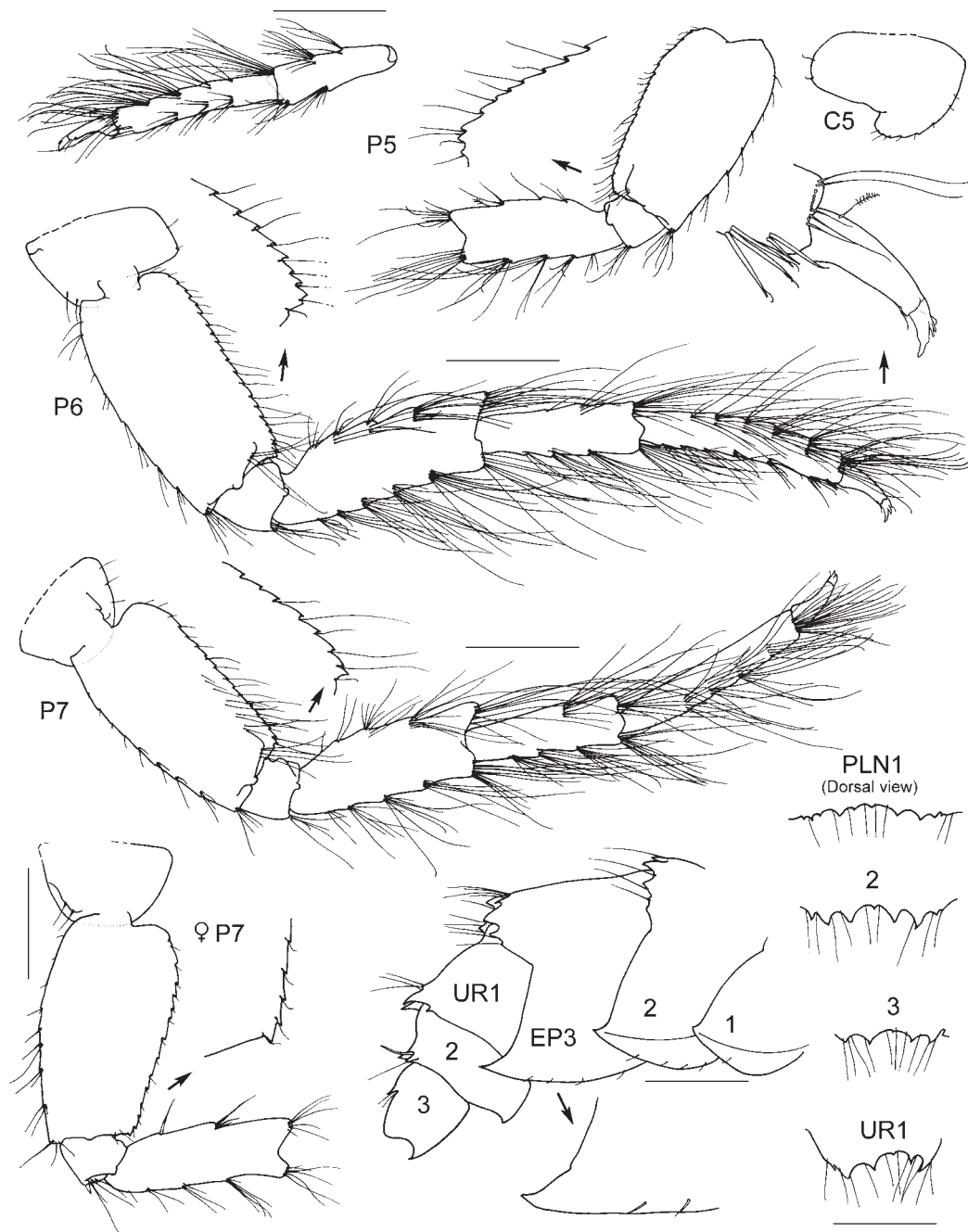


FIGURE 10. *Dulichiella appendiculata* (Say, 1818), neotype male, 8.1 mm, USNM 1092318, female, 6.7 mm, USNM 1092319, McQueen Inlet, Saint Catherines Island, Georgia, USA. Scales represent 0.5 mm.

Gnathopod 1 coxa anteroventral corner not produced, anterior margin concave, posteroventral corner notch present; carpus subequal in length to propodus; propodus small, linear, palm slightly convex, palm defined by posterodistal corner, with posterodistal robust setae. **Gnathopod 2** coxa posteroventral corner notch present; (larger) **propodus distolateral crown with 4 rounded spines, fourth spine weak or occasionally absent**, palm sinusoidal, posterodistal corner produced, upturned, posterodistal corner dactylus fitting into corner; dactylus apically blunt; (smaller) merus with sharp posteroventral spine; palm convex,

without robust setae, posterodistal corner with robust setae; dactylus with 1 or 2 setae on anterior margin. Pereopod 5 dactylar unguis anterior margin with 2 accessory spines. **Pereopods 6–7 basis, merus, carpus and propodus with bunches of long slender setae.** Pereopod 6 basis posterior margin straight; **dactylar unguis anterior margin with 2 accessory spines.** Pereopod 7 basis posterior margin straight.

Pleonite/urosomite dorsal spine formula (7-7-7-5-4-2). **Pleonites 1–3 with dorsal setae.** Epimeron 1 posteroventral corner with small acute or subacute spine. Epimeron 2 posteroventral corner acute. Epimeron 3 posteroventral margin smooth. Urosomite 1 with spine at midline, no conspicuous medial gape. Urosomite 2 with two groups of 1–3 small dorsolateral robust setae. Urosomite 3 with dorsal setae, with 2 dorsal spines. Uropod 3 outer ramus very long, about 2 x peduncle. Telson with dorsal robust setae.

Female (sexually dimorphic characters). Gnathopod 2 subequal in size, similar to smaller gnathopod 2 of male; palm convex; dactylus posterior margin smooth. Pereopod 7 basis expanded, posterior margin tapering distally.

Habitat. Marine epibenthic, polyhaline on sponges, hydroids and bryozoans (Feeley & Wass, 1971; Wass, 1972).

Remarks. The distribution records from this species are based mainly on LeCroy (2000) and LeCroy (*in litt.*). As Shoemaker (1955: 50) points out (confirmed by LeCroy, 2000: 77) the record of *Melita dentata* of Pearse (1912) from Cameron, Louisiana is actually *D. appendiculata*.

The illustrations presented here (figs 7–10) agree with the illustrations of LeCroy (2000: fig. 125) except the number of spines on the male gnathopod 2 distolateral crown. LeCroy shows three spines and we show four. LeCroy did not count the first spine on the crown, which appears as a shelf, and her illustration does not show a fourth spine. In *D. appendiculata* the fourth spine is weakly developed or missing. We have illustrated a specimen with a weakly developed spine and in LeCroy's specimen the spine is absent.

Dulichhiella appendiculata has four spines on the distolateral crown of male gnathopod 2 (the fourth spine is not well developed) and a 7-7-7-5-4 pleonite/urosomite formula. Five other species share these character states: *D. cuvettensis*; *D. fresnelii*; *D. guinea*; *D. lecroyae*; and *D. pacifica*. *Dulichhiella appendiculata* differs from all of these species, except *D. guinea*; in having bunches of long slender setae on the basis, merus, carpus and propodus of male pereopods 6 and 7. However *D. guinea* has a very setose dorsal pleosome.

Dulichhiella appendiculata and *D. lecroyae* have an overlapping distribution along the Florida coast. These species are similar, particularly in the distolateral crown, but they differ in the shape of the lateral cephalic lobe which is truncated in *D. appendiculata* (rounded in *D. lecroyae*); the posterior-most spine (4) on the distolateral crown of male gnathopod 2 which is vestigial or absent in *D. appendiculata* (always well developed in *D. lecroyae*); the palm of female gnathopod 2 which is convex in *D. appendiculata* (concave in *D. lecroyae*); the dactyli of the pereopods which have two accessory spines in *D. appendiculata* (one in *D. lecroyae*); and the posteroventral corners of epimera 1 and 2 which have small acutely produced corners in *D. appendiculata* (subquadrate in *D. lecroyae*).

Dulichhiella appendiculata can be separated from the Red Sea species, *D. fresnelii*, by the smooth posterior margin of the dactylus of female gnathopod 1 (crenulate in *D. fresnelii*) and the short telson (longer in relation to its width in *D. fresnelii*).

Dulichhiella appendiculata can be distinguished from the Indo Pacific species *D. cuvettensis* and *D. pacifica* as follows. *Dulichhiella cuvettensis* has a longer mandibular palp article 3, the pereopods have only one accessory spine each on the dactyli and in the male there are no bunches of long slender setae on pereopods 6 and 7. *Dulichhiella pacifica* has an undefined, rounded posterodistal corner on the palm of male gnathopod 1 (defined, subquadrate in *D. appendiculata*), male pereopods 6 and 7 with bunches of long, slender setae only on the carpus and propodus (basis, merus, carpus and propodus in *D. appendiculata*), pereopods 5 to 7 with one accessory spine each on the dactyli (2 in *D. appendiculata*) and the telson is longer than broad (as long as broad in *D. appendiculata*).

LeCroy (2000) indicated a possible third species of *Dulichhiella* in the south-eastern United States, living

in “high salinity grass and algal beds of south Florida and St. Joe Bay on the Florida panhandle”. These specimens have a small fourth spine on the distolateral crown of the male second gnathopod, fewer setae than usual on the basis of pereopods 6 and 7 and a somewhat flatter palm on the female second gnathopod. These characteristics fall within the range of variation for *D. appendiculata*.

Distribution. USA. *Delaware*: Delaware Bay (Watling & Maurer, 1972, unconfirmed). *Virginia*: Chesapeake Bay (Wass, 1965, 1972; Feeley & Wass, 1971, unconfirmed). *South Carolina*: Sewee Bay (SERTC). *Georgia*: McQueen Inlet, Saint Catherines Island. *Florida*: Indian River Lagoon; Battlepoint Key, Florida Bay; Bonita Beach; Lemon Bay; Bird Key, Sarasota Bay; Tampa Bay; Alligator Harbor; Crooked Island Sound (all USNM); St. George Basin and Apalachicola Estuary, north-western Florida (Sheridan, 1979). *Louisiana*: Cameron (Pearse, 1912).

***Dulichchiella australis* (Haswell, 1879)**

(Figs 11–13)

Melita australis Haswell, 1879: 264, pl. 9, figs 6–7. –Haswell, 1882: 252.

Melita fresnelii. –Della Valle, 1893: 708 (in part) (not pl. 60, fig. 6, copy of gnathopod 2 of *M. anisochir* Krøyer, 1845).

–Stebbing, 1906: 428 (in part). –Stebbing, 1910: 596–597, 642. –Chilton, 1921: 70. –Hale, 1927: 314.

Dulichchiella australis. –Karaman & Barnard, 1979: 153. –Barnard & Barnard, 1983: 668. –Hutchings, *et al.*, 1989: 362. –Lowry & Stoddart, 2003: 177. –Lowry & Springthorpe, 2005: 286, figs 50–53.

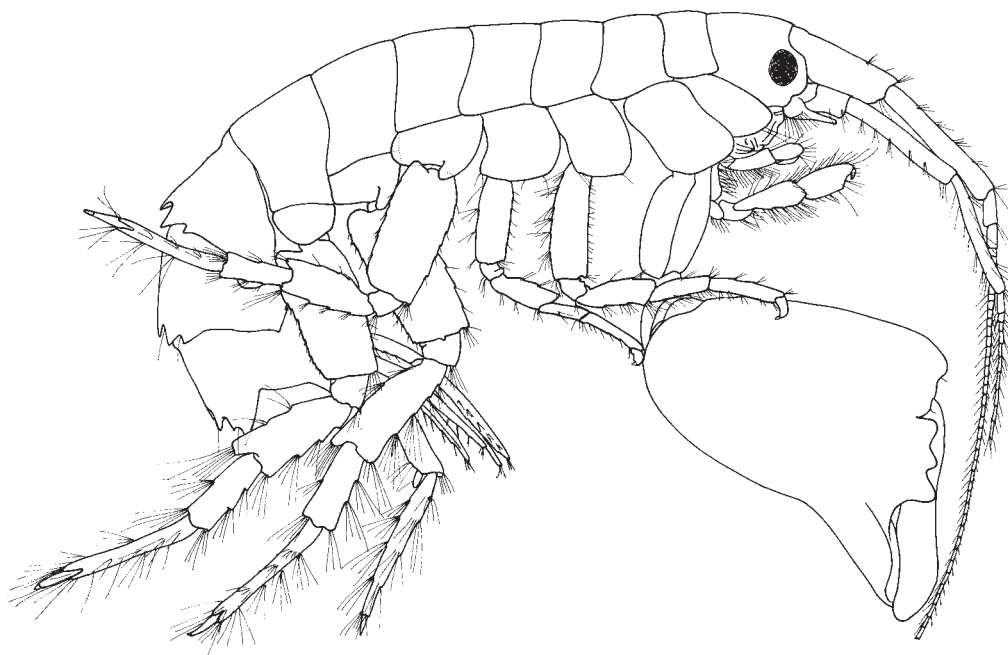


FIGURE 11. *Dulichchiella australis* (Haswell, 1879), male, 10.0 mm, AM P60600, west side of Box Head, Broken Bay, New South Wales, Australia. (After Lowry & Springthorpe, 2005: fig. 50).

Type material. Syntypes: 5 specimens, AM G5393; 1 specimen AM P3495, Port Jackson, New South Wales, Australia (approx. 33°51'S 151°16'E).

Type locality. Port Jackson, New South Wales, Australia (33°51'S 151°16'E).

Additional material. Male, 10 mm, AM P60600; female, AM P60601, west side of Box Head, Broken Bay, New South Wales, Australia.

Description. Based on male, 10 mm, AM P60600 and female, AM P60601. Body large. Head eyes round;

lateral cephalic lobe broad, truncated, anteroventral corner with slender setae. **Antenna 1 peduncular article 1** shorter than article 2, **with 4 robust setae along posterior margin**. Antenna 2 peduncular article 2 cone gland reaching at least to end of peduncular article 3; article 4 subequal to article 5. Mandibular palp article 1 about as long as broad, inner margin article 1 produced distally; article 2 shorter than article 3.

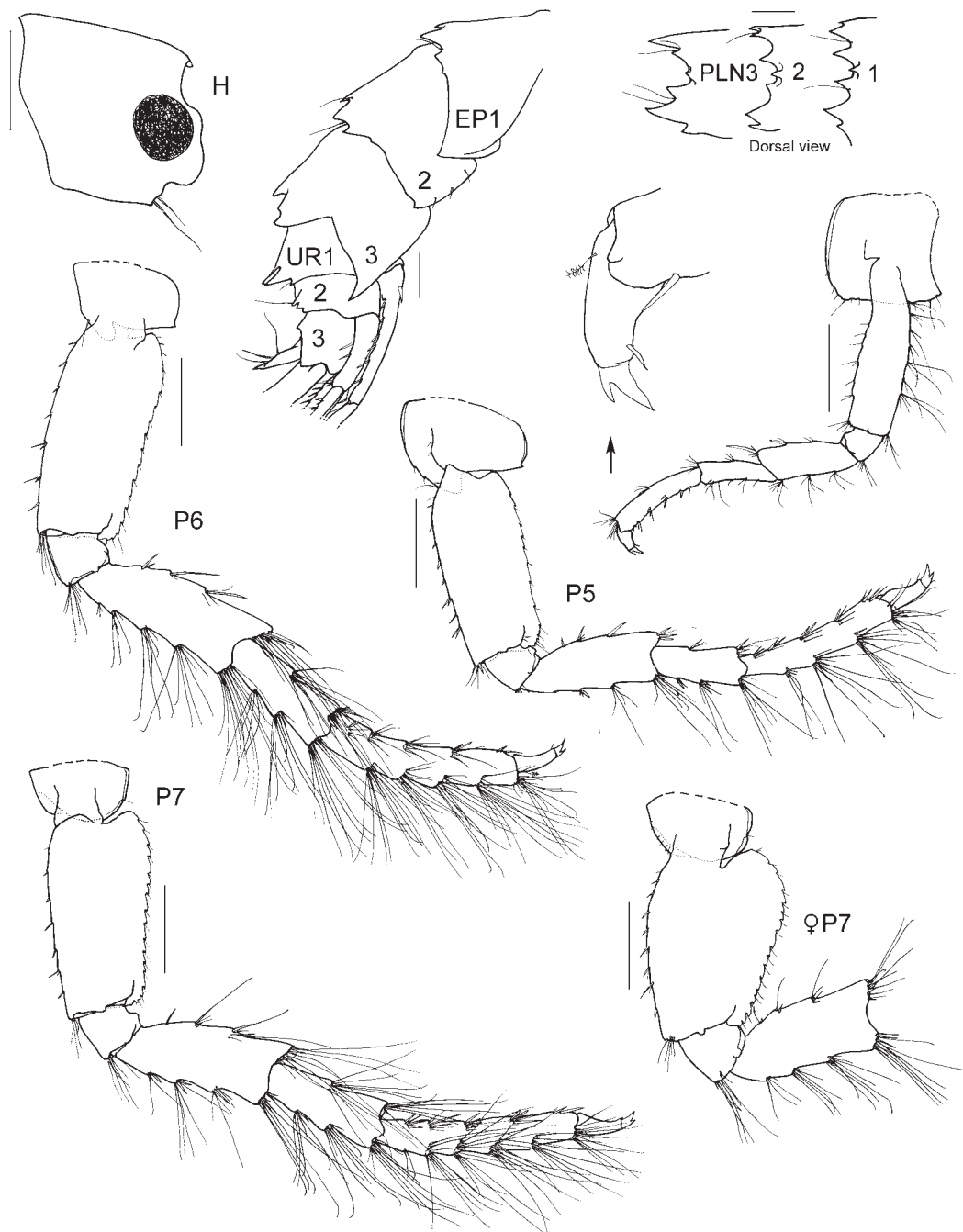


FIGURE 12. *Dulichiella australis* (Haswell, 1879), male, 10.0 mm, AM P60600, female, AM P60601, west side of Box Head, Broken Bay, New South Wales, Australia. Scales represent 0.5 mm. (After Lowry & Springthorpe, 2005 figs 51, 53).

Gnathopod 1 coxa anteroventral corner not produced, anterior margin straight, posteroventral corner notch present; carpus subequal in length to propodus; propodus small, linear, palm slightly convex or straight, palm defined by posterodistal corner, without posterodistal robust setae. **Gnathopod 2** coxa posteroventral corner notch present; (larger) **propodus distolateral crown with 3 indistinct rounded spines**, palm straight,

posterodistal corner produced, upturned, with dactylus fitting into corner; dactylus apically blunt; (smaller) merus with sharp posteroventral spine; palm straight, lined with robust setae, posterodistal corner with robust setae; dactylus with 4 setae on anterior margin. Pereopod 5 dactylar unguis anterior margin with accessory spine. Pereopods 6–7 carpus and propodus with bunches of long slender setae. **Pereopod 6** basis posterior margin straight; **dactylar unguis anterior margin with accessory spine**. Pereopod 7 basis posterior margin straight.

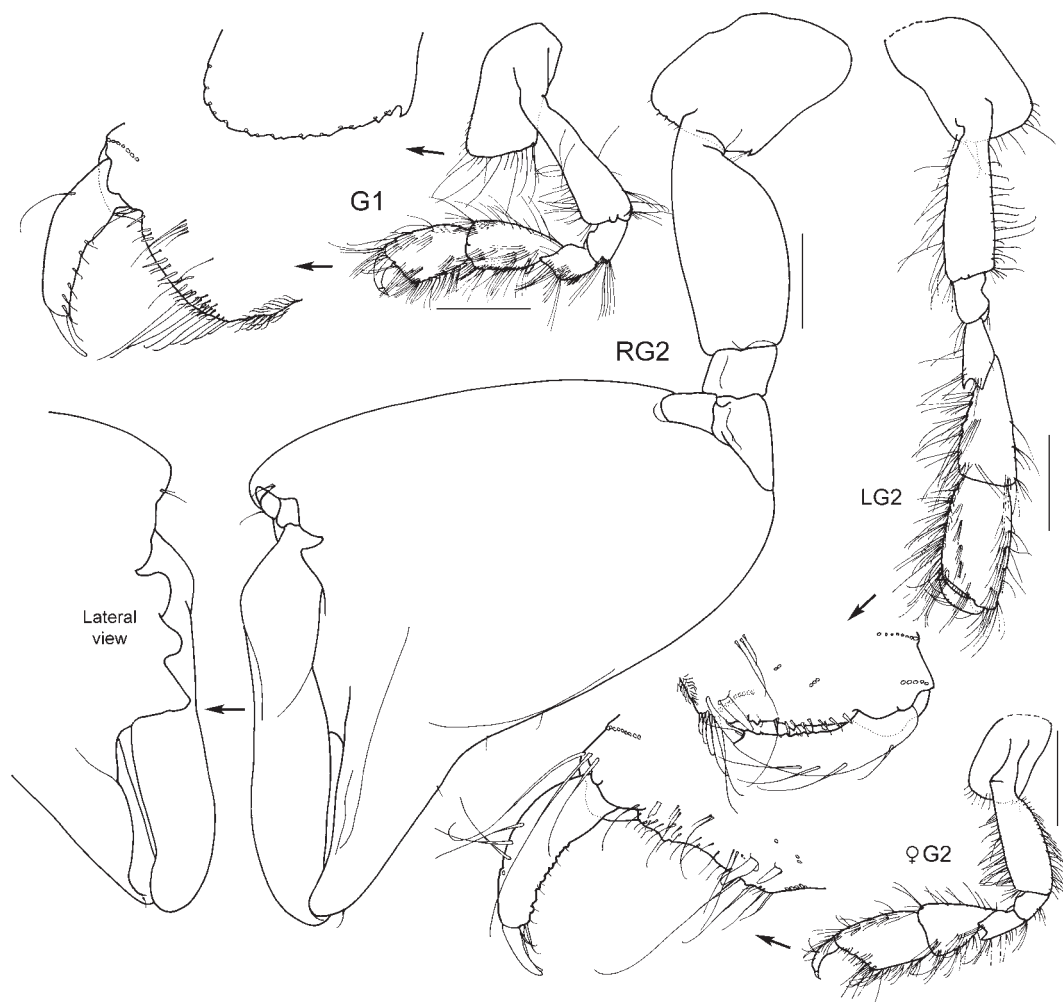


FIGURE 13. *Dulichiella australis* (Haswell, 1879), male, 10.0 mm, AM P60600, female, AM P60601, west side of Box Head, Broken Bay, New South Wales, Australia. Scales represent 0.5 mm. (After Lowry & Springthorpe, 2005: fig. 52).

Pleonite/urosomite dorsal spine formula (7-7-7-5-4-2). Pleonites 1–3 with sparse dorsal setae. Epimeron 1 posteroventral corner with small acute or subacute spine. Epimeron 2 posteroventral corner acute. Epimeron 3 posteroventral margin smooth. Urosomite 1 with three dorsal spines. Urosomite 2 with two groups of 1–3 small dorsolateral robust setae. Urosomite 3 without dorsal setae, with 2 dorsal spines. Uropod 3 outer ramus very long, length about 2 x peduncle. Telson with dorsal robust setae.

Female (sexually dimorphic characters). Gnathopod 2 subequal in size, similar to smaller gnathopod 2 of male; palm slightly concave; dactylus posterior margin minutely crenulate. Pereopod 7 basis expanded, posterior margin tapering distally.

Habitat. Marine epibenthic, living among bryozoans, sponges, ascidians and algae in 4 to 120 m depth.

Remarks. Three Indo Pacific species, *Dulichiella australis*, *D. oahu* and *D. tulear*, all have three spines on the distolateral crown of male gnathopod 2 and a 7-7-7-5-4/6-2 pleonite/urosomite spine formula. *Duli-*

chiella australis differs from *D. tulear* in the narrower propodus of the smaller male gnathopod 2, and in the smooth posteroventral margin on epimeron 3 (minutely serrate in *D. tulear*). Unfortunately the setation of pereopods 6 and 7 is not known in *D. tulear*. *Dulichchiella australis* is very similar to *D. oahu*. The main differences between these species are antenna 1 peduncular article 1 with four robust setae in *D. australis* and two robust setae in *D. oahu*, and the pereopodal dactyli which have one accessory spine in *D. australis* and two accessory spines in *D. oahu*.

Distribution. Australia. *Queensland*: Lizard Island (Lowry & Springthorpe, 2005). *New South Wales*: Julian Rocks, Byron Bay; Mary's Rock, Cook Island; Split Solitary Island; Coffs Harbour; Boambee Creek, Sawtell (all Lowry & Springthorpe, 2005); Tacking Point (Haswell, 1879); Manning River (Stebbing, 1910); Port Stephens; off Burwood Beach; Box Head, Broken Bay; off Long Reef (all Lowry & Springthorpe, 2005); Port Jackson (Haswell, 1879); Clark Island, Port Jackson; Botany Bay; off Wattamolla; off Wollongong; Jervis Bay; Twofold Bay (all Lowry & Springthorpe, 2005). *Victoria*: Western Port (Lowry & Springthorpe, 2005). *Tasmania*: Esperance Point, D'Entrecasteaux Channel (Lowry & Springthorpe, 2005). *South Australia*: Sanders Bank, Kangaroo Island (Chilton, 1921); Spencers Gulf (Lowry & Springthorpe, 2005).

***Dulichchiella cotesi* (Giles, 1890)**

(Figs 14–16)

Melita cotesi Giles, 1890: 64, pl. 2, fig. 1. –Della Valle, 1893: 895.

Melita fresnelii. –Stebbing, 1906: 423 (in part).

Type material. Holotype male, BMNH 2006.602, Andaman Sea.

Type locality. Andaman Islands, Indian Ocean.

Additional material. Male, 5.3 mm, MCSN, female, 6.4 mm, MCSN, 5 specimens, MCSN, outside Port Meadows, Andaman Islands (12°01'N 92°45'E), 1–8 m, Ulrich Schiecke, 22 December, 1978.

Description. Based on male, 5.3 mm, MCSN and female, 6.4 mm, MCSN. Body large. Head eyes round; lateral cephalic lobe broad, truncated, anteroventral corner with slender setae. Antenna 1 peduncular article 1 shorter than article 2, with 4 robust setae along posterior margin. Antenna 2 peduncular article 2 cone gland reaching to end of peduncular article 3; article 4 subequal to article 5. Mandibular palp article 1 about as long as broad, inner margin article 1 produced distally.

Gnathopod 1 coxa anteroventral corner not produced, anterior margin straight, not produced, small posteroventral corner notch present; carpus subequal in length to propodus; propodus "stout", palm slightly convex, defined by posterodistal corner, with posterodistal robust seta. **Gnathopod 2** coxa small posteroventral corner notch present; (larger) **propodus distolateral crown with 2 rounded or subacute spines**, palm sinuoid, posterodistal corner produced, straight, dactylus fitting against corner; dactylus apically blunt; (smaller) merus with sharp posteroventral spine; palm straight, without robust setae, posterodistal corner with robust setae; dactylus with 3 setae on anterior margin. Pereopod 5 dactylar unguis anterior margin with accessory spine. Pereopods 6–7 carpus and propodus unknown. **Pereopod 6** basis posterior margin straight; **dactylar unguis anterior margin with accessory spine**. Pereopod 7 basis posterior margin slightly concave.

Pleonite/urosomite dorsal spine formula (7-7-7-5-6-2). Pleonites 1–3 with sparse dorsal setae. Epimeron 1 posteroventral corner with small acute or subacute spine. **Epimeron 2 posteroventral corner subquadrate**. Epimeron 3 posteroventral margin smooth. Urosomite 1 with spine at midline, no conspicuous medial gape. Urosomite 2 with two groups of 1–3 small dorsolateral robust setae. Urosomite 3 with two groups of small dorsal setae, with 2 dorsal spines. **Uropod 3 outer ramus** very long, **about 2 x peduncle**. Telson with dorsal robust setae.

Female (sexually dimorphic characters). Gnathopod 2 subequal in size, similar to smaller gnathopod 2 of male; palm concave; dactylus posterior margin slightly crenulate. Pereopod 7 basis expanded, posterior margin tapering distally.

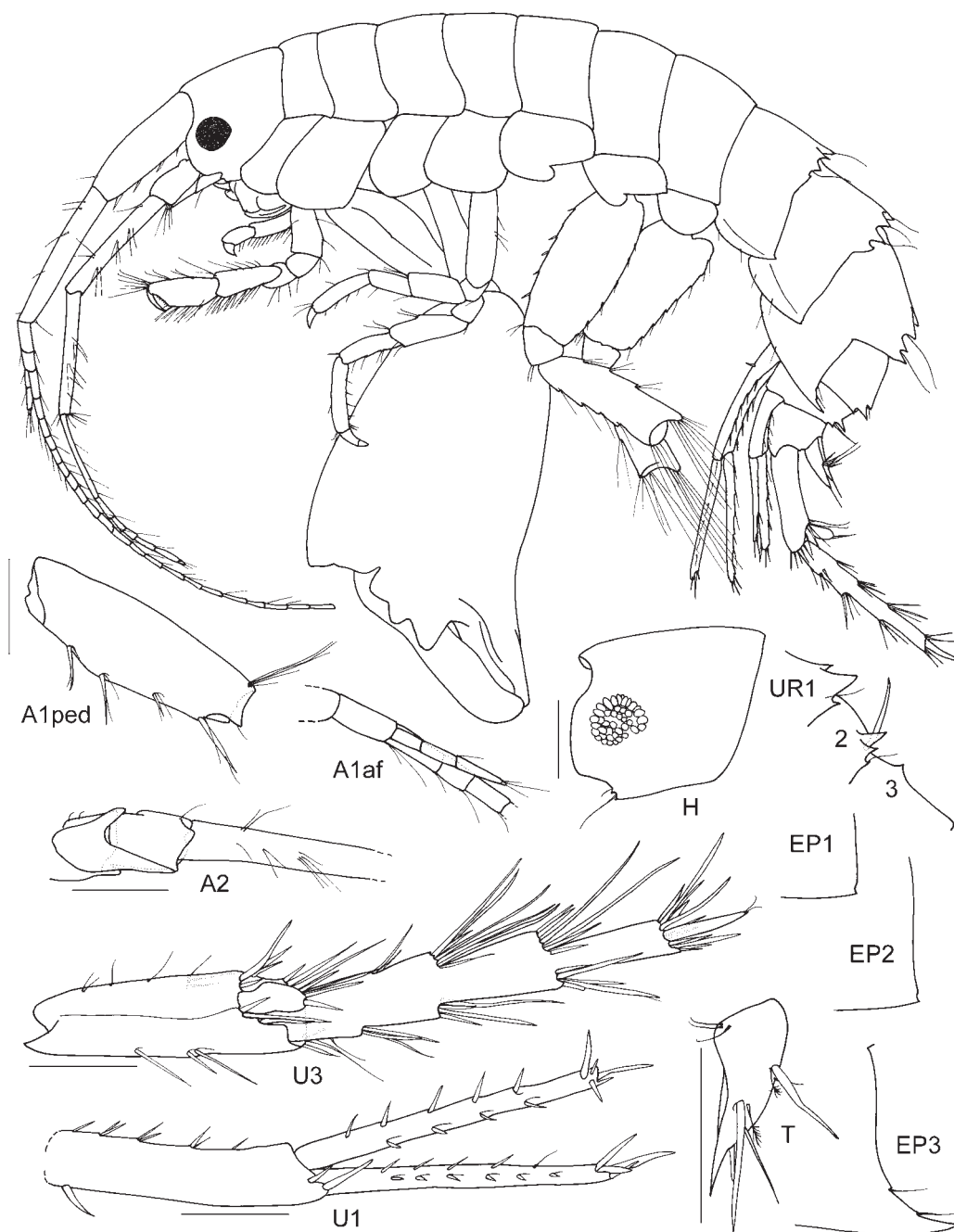


FIGURE 14. *Dulichiella cotesi* (Giles, 1890), male, 5.3 mm, MCSN, Port Meadows, Andaman Islands. Scales represent 0.2 mm.

Habitat. Marine epibenthic, 1–8 m depth.

Remarks. Giles (1890) original illustrations of the males second gnathopod show no spines on the distolateral crown. Because of this and other inconsistencies in the original description *D. cotesi* has remained unidentifiable for 115 years. However, the discovery of the holotype by Miranda Lowe (unregistered in the collections of the Natural History Museum, London) and new collections from the Andaman Islands (made by Ulrich Schiecke for the Museo Civico di Storia Naturale, Verona) has allowed us to redescribe the species.

Dulichiella cotesi and *D. tomioka* **sp. nov.** both apparently have only two spines on the distolateral crown of male gnathopod 2. *Dulichiella cotesi* differs from *D. tomioka* in a slightly different dorsal spine formula (7-7-7-5-6-2) (7-9-7-5-6-2 in *D. tomioka*); in the dactyli of the pereopods which have one accessory spine in *D. cotesi* (two accessory spines in *D. tomioka*); and in the basis of pereopod 7 which has a concave posterior mar-

gin (straight in *D. tomioka*). The female of *D. tomioka* is not known.

Distribution. Andaman Islands, Indian Ocean.

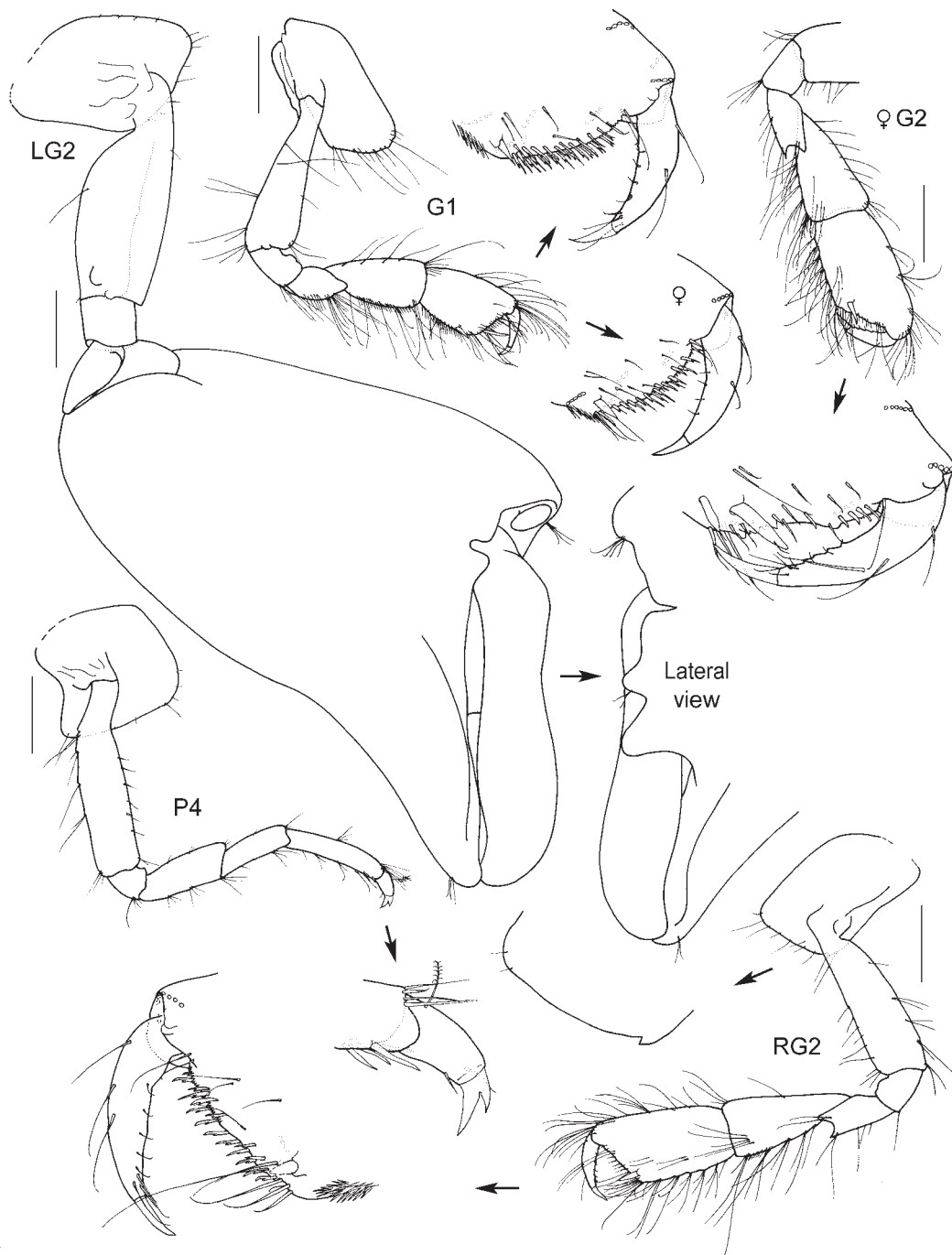


FIGURE 15. *Dulichiella cotesi* (Giles, 1890), male, 5.3 mm, MCSN, female, 6.4 mm, MCSN, Port Meadows, Andaman Islands. Scales represent 0.2 mm.

***Dulichiella cuvettensis* Appadoo & Myers, 2005**
(Figs 17–18)

Dulichiella appendiculata. –Ledoyer, 1986: 187, fig. 9 (Mau).

Dulichiella cuvettensis Appadoo & Myers, 2005: 225, fig. 4.

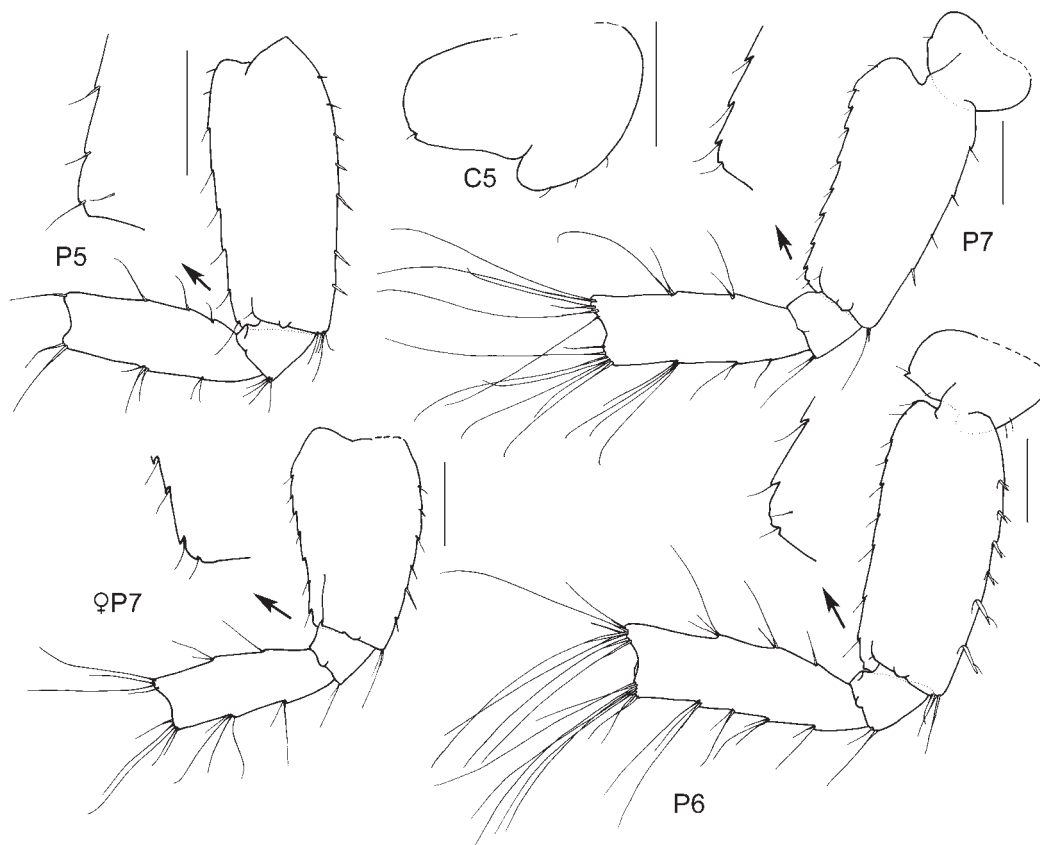


FIGURE 16. *Dulichiella cotesi* (Giles, 1890), male, 5.3 mm, MCSN, female, MCSN, Port Meadows, Andaman Islands. Scales represent 0.2 mm.

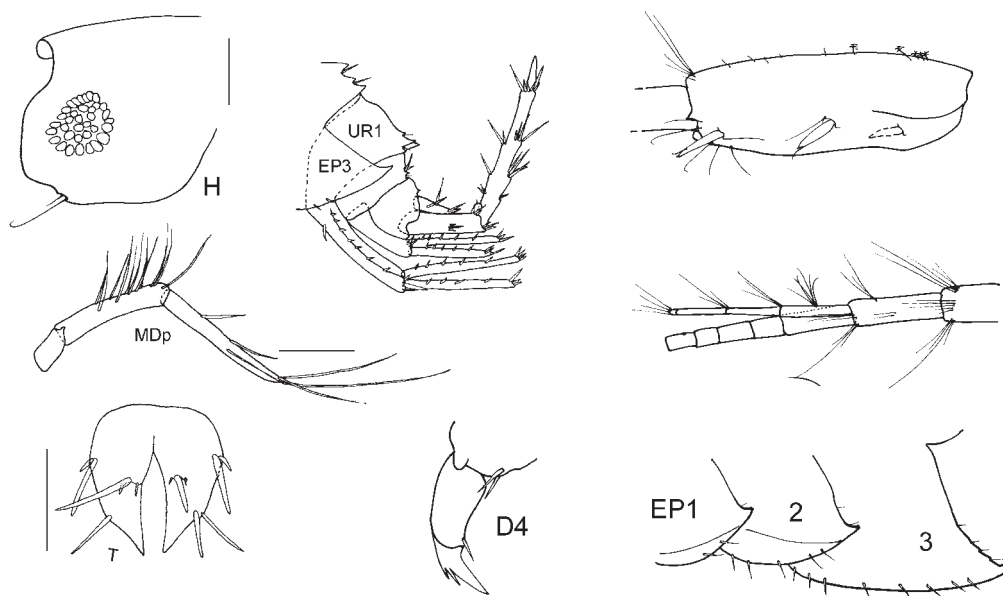


FIGURE 17. *Dulichiella cuvettensis* Appadoo & Myers, 2005, holotype male, 5 mm, AM P67233, La Cuvette, Mauritius. Scale for MDp represents 0.1 mm, H represents 0.5 mm, remainder represent 0.2 mm. (MDp, UR and T after Appadoo & Myers, 2005: fig. 4).

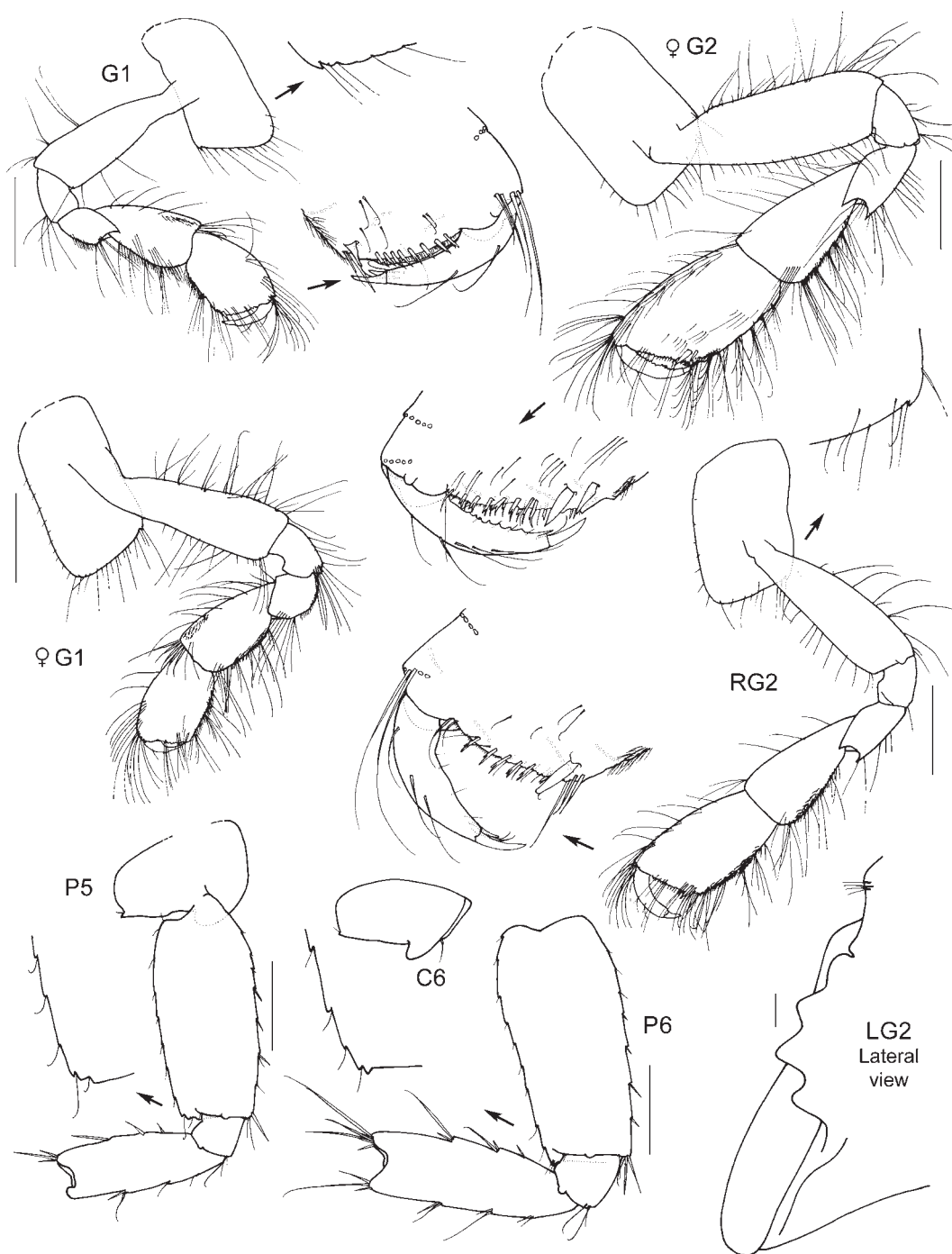


FIGURE 18. *Dulichiella cuvettensis* Appadoo & Myers, 2005, holotype male, 5 mm, AM P67233, La Cuvette, Mauritius, female paratype, 4.8 mm, AM P67234, Bain Boeuf, Mauritius. Scales represent 0.2 mm. (LG2 after Appadoo & Myers, 2005: fig. 4).

Type material. Holotype male, 5 mm, AM P67233, La Cuvette, Mauritius (20°00'S 57°34'12"E), *Sargassum* sp., 1 m, C. Appadoo, 12 October 1999. Paratypes 3 specimens (1 female, 7 mm, 2 males, AM P67234), Bain Boeuf, Mauritius (19°59'S 57°36'E), *Sargassum* sp. and *Pocockiella variegata*, 1 m, C. Appadoo, 12 October 1999.

Type locality. Among *Sargassum* sp., La Cuvette, Mauritius (20°00'N 57°34.2'E).

Description. Based on holotype male, 5 mm, AM P67233 and paratype female, 7 mm, AM P67234. Body

small. Head eyes round; lateral cephalic lobe broad, truncated, anteroventral corner with slender setae. Antenna 1 peduncular article 1 shorter than article 2, with 3 robust setae along posterior margin. Antenna 2 peduncular article 4 subequal to article 5. Mandibular palp article 1 about twice as long as broad, inner margin article 1 produced distally; article 2 shorter than article 3.

Gnathopod 1 coxa anteroventral corner not produced, anterior margin straight, posteroventral corner notch present; carpus longer than propodus; propodus small, linear, palm straight, defined by posterodistal corner, with posterodistal robust setae. **Gnathopod 2** coxa posteroventral corner notch present; (larger) **propodus distolateral crown with 4 rounded spines**, palm sinusoidal, posterodistal corner produced, slightly upturned, dactylus fitting against corner; dactylus apically blunt; (smaller) merus with sharp posteroventral spine; palm straight, margin without robust setae, corner with robust setae; with 1 or 2 setae on anterior margin. Pereopod 4 dactylar unguis anterior margin with 2 accessory spines. **Pereopods 6 basis and merus without bunches of long slender setae** (distal articles unknown). Pereopod 7 unknown.

Pleonite/urosomite dorsal spine formula (7-7-7-5-4-2). Pleonites 1–3 with sparse dorsal setae. Epimeron 1 posteroventral corner with small acute or subacute spine. Epimeron 2 posteroventral corner acute. Epimeron 3 posteroventral margin smooth. Urosomite 1 with spine at midline, no conspicuous medial gape. Urosomite 2 with two groups of 1–3 small dorsolateral robust setae. Urosomite 3 without dorsal setae; with 2 dorsal spines. Uropod 3 outer ramus very long, about 2 x peduncle. Telson with dorsal robust setae.

Female (sexually dimorphic characters). Gnathopod 2 subequal in size, similar to smaller gnathopod 2 of male; palm concave; dactylus posterior margin crenulate. Pereopod 7 basis expanded, posterior margin slightly convex, tapering distally.

Habitat. Marine epibenthic, living on mixed algae such as *Padina*, *Pocockiella*, *Sargassum*, *Turbinaria* and *Ulva*, intertidal.

Remarks. *Dulichiesta cuvettensis* has four spines on the distolateral crown of male gnathopod 2 and a 7-7-7-5-4-2 pleonite/urosomite formula. Four other species share these characters: the Atlantic species *D. appendiculata* and *D. lecroyae*, the Red Sea species *D. fresnelii* and the South Pacific species *D. pacifica*.

Dulichiesta cuvettensis is most similar to *D. fresnelii* and *D. pacifica*. It differs from both of these species in having two accessory spines on the dactyli of pereopods 5 and 6 and presumably pereopod 7 and in lacking bunches of long, slender setae on any articles of male pereopod 6 and presumably 7. Pereopod 7 is missing in all specimens of *D. cuvettensis* available to us. The state of the pereopod is presumed based on the character consistency in other species. *Dulichiesta cuvettensis* is further distinguished from *D. pacifica* by the corner of the male gnathopod 1 palm which is subquadrate in *D. cuvettensis* and rounded in *D. pacifica*.

Dulichiesta cuvettensis can be distinguished from the Atlantic species, *D. appendiculata* and *D. lecroyae* by the longer mandibular palp article 3 and the dactyli of the pereopods which have two accessory spines in *D. cuvettensis* and only 1 accessory spine each in the two Atlantic species.

Distribution. Mauritius. La Cuvette, Bain Boeuf and Grand Baie, Indian Ocean (Appadoo & Myers, 2005).

***Dulichiesta fresnelii* (Audouin, 1826)**

(Figs 19–22)

Gammarus fresnelii Audouin, 1826: 93, pl. 11, fig. 3.

Amphithoe fresnelii. –H. Milne Edwards, 1830: 377. –H. Milne Edwards, 1840: 38.

Paramoera fresnelii. –Miers, 1875: 75.

Melita fresnelii. –Della Valle, 1893: 708 (in part) (not pl. 60, fig. 6 copy of gnathopod 2 of *M. anisochir* Krøyer, 1845).

–Spandl, 1924: 53, fig. 19

Dulichiesta fresnelii. –Karaman & Barnard, 1979: 153. –Barnard & Barnard, 1983: 668 (in part = *D. cotesi* (Giles, 1890),

D. anisochir Krøyer, 1845). –Irie & Nagata, 1962: 19 (= *D. tomioka* **sp. nov.**).

Not *Melita fresnelii*. –J.L. Barnard, 1955: 13 (= *D. oahu* **sp. nov.**).

Not *Melita fresnelii*. –Stebbing, 1910: 596–597, 642 (= *D. australis* (Haswell, 1879)). –Kunkel, 1910: 31, fig. 11 (= *D. lecroyae* **sp. nov.**). –Pearse, 1912: 371 (= *D. lecroyae* **sp. nov.**, LeCroy, pers. comm.). –Chilton, 1921: 70 (= *D. australis* (Haswell, 1879)). –Hale, 1927: 314 (= *D. australis* (Haswell, 1879)). –Shoemaker, 1941: 187 (= *D. spinosa* Stout, 1912). –Nagata, 1964: 9 (= *D. tomioka* **sp. nov.**).

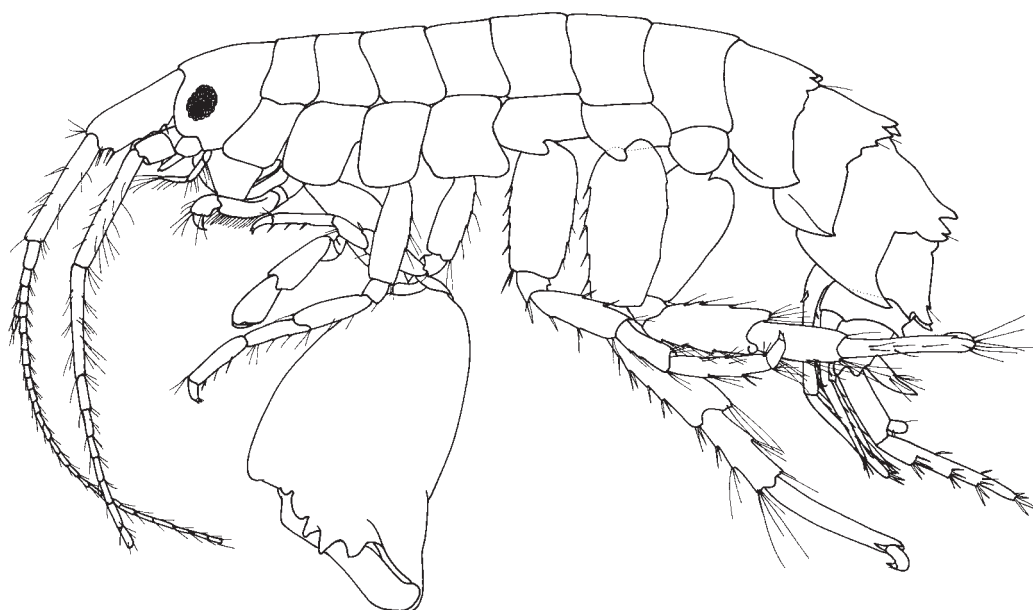


FIGURE 19. *Dulichiella fresnelii* (Audouin, 1826), neotype male, 6.6 mm, NHMW 19616, Little Bitter Lake, Suez Canal, Egypt.

Type material. Neotype male, 6.6 mm, NHMW 19616, Little Bitter Lake, Suez Canal, Egypt, Engl. Zool. Suez-Kanal Expedition, 17 October 1924.

Type locality. Little Bitter Lake, Suez Canal, Egypt (approx. 30°20'N 32°20'E).

Additional material. 1 female, 6.7 mm, NHMW 20944, 8 males, 15 females, NHMW 20945, Little Bitter Lake, Suez Canal, Egypt. 3 specimens NMHW 19617, Le Cap, Engl. Zool. Suez-Kanal Expedition, 24 Dec 1924.

Description. Based on neotype male, 6.6 mm, NHMW 19616 and female, 6.7 mm, NHMW 20944. Body large. Head eyes round; lateral cephalic lobe broad, truncated, anteroventral corner with slender setae. Antenna 1 peduncular article 1 shorter than article 2, with 4 robust seta on posterior margin. Antenna 2 peduncular article 2 cone gland not reaching to end of peduncular article 3; article 4 longer than article 5. Mandibular palp article 1 about as long as broad, inner margin article 1 not produced distally; article 2 subequal to article 3.

Gnathopod 1 coxa anteroventral corner not produced, anterior margin concave, posteroventral corner notch present; carpus longer than propodus; propodus "stout", palm straight, palm defined by posterodistal corner, with posterodistal robust setae. **Gnathopod 2** coxa posteroventral corner notch present; (larger) **propodus distolateral crown with 4 rounded or subacute spines, fourth spine well developed**, palm sinusoidal, posterodistal corner produced, upturned, dactylus overlapping corner; dactylus apically hooked; (smaller) merus with sharp posteroventral spine; palm slightly convex, without robust setae, posterodistal corner with robust setae; dactylus with more than 2 setae on anterior margin. Pereopod 5 dactylar unguis anterior margin with 2 accessory spines. Pereopods 6–7 carpus and propodus with bunches of long slender setae. Pereopods 6–7 carpus and propodus with bunches of long slender setae. **Pereopod 6** basis posterior margin straight; **dactylar unguis anterior margin with one accessory spine**. **Pereopod 7** basis posterior margin tapering distally.

Pleonite/urosomite dorsal spine formula (7-7-7-5-4-2). Pleonites 1–3 with sparse dorsal setae.

Epimeron 1 posteroventral corner with small acute or subacute spine. Epimeron 2 posteroventral corner acute. Epimeron 3 posteroventral margin smooth. Urosomite 1 with three dorsal spines. Urosomite 2 with two groups of 1–3 small dorsolateral robust setae. Urosomite 3 without dorsal setae. Uropod 3 outer ramus very long, about 2 x peduncle. Telson with dorsal robust setae.

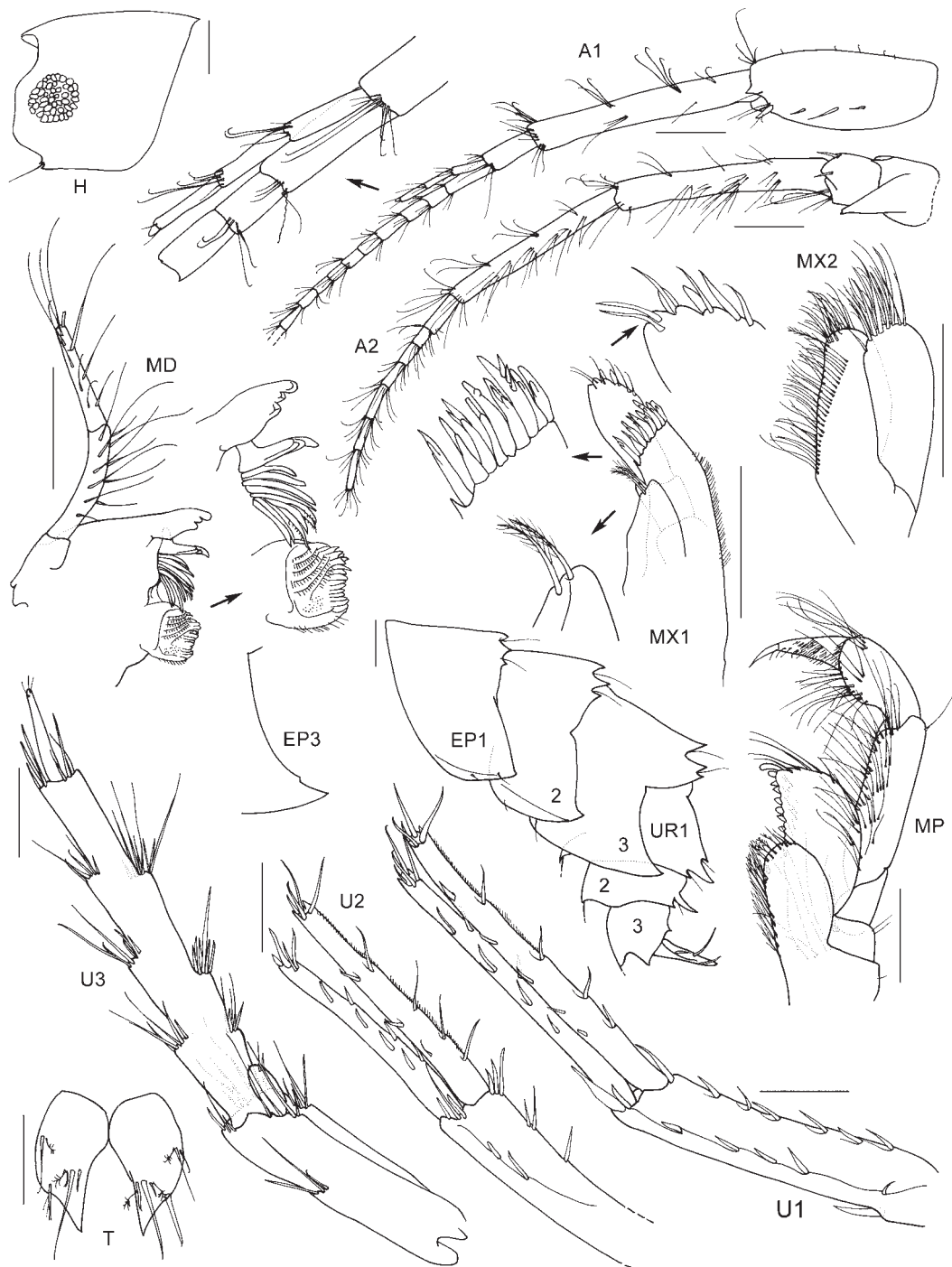


FIGURE 20. *Dulichiella fresnelii* (Audouin, 1826), neotype male, 6.6 mm, NHMW 19616, Little Bitter Lake, Suez Canal, Egypt. Scales represent 0.2 mm.

Female (sexually dimorphic characters). Gnathopod 2 subequal in size, similar to smaller gnathopod 2 of male; palm slightly sinusoidal; dactylus posterior margin crenulate. Pereopod 7 basis expanded, posterior margin slightly convex, tapering distally.

Habitat. Marine epibenthic.

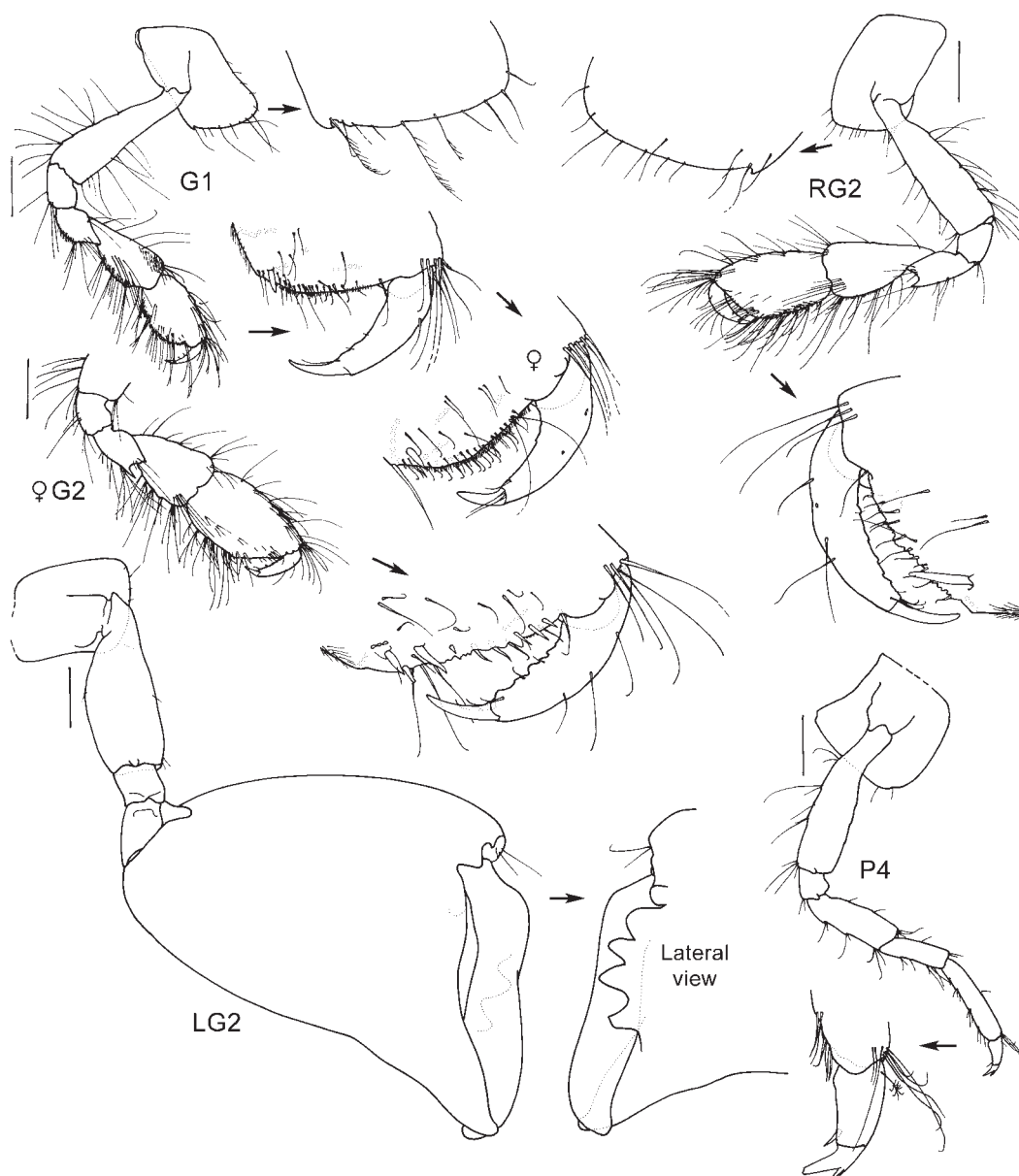


FIGURE 21. *Dulichiella fresnelii* (Audouin, 1826), neotype male, 6.6 mm, NHMW 19616, female, 6.7 mm, NHMW 20944, Little Bitter Lake, Suez Canal, Egypt. Scales represent 0.2 mm.

Remarks. Many collections have been misidentified as *D. fresnelii*, mainly because of the indiscriminate synonymy of Della Valle (1893). In the text of Audouin (1826) there are no diagnostic characters to distinguish *D. fresnelii* and the type material of the species is no longer extant. The type locality as given by Audouin (1826) is Egypt. It is almost certainly from the Red Sea, because exhaustive collecting in the Mediterranean Sea has never turned up a species of *Dulichiella* (see Karaman, 1982).

The original illustrations of *D. fresnelii* are too general to distinguish it as a particular species. Spandl (1924) had at least one male of a *Dulichiella* from the Red Sea, which he called *Melita fresnelii*. He illustrated the proximal ends of the first and second antennae, the distal end of a male gnathopod 2 and the dorsum of pleonites 1 to 3 and urosomite 1, but these illustrations are not enough to identify the species. This is also true for the Nayar's (1959; 1966) records of *D. fresnelii* from the east coast of India.

We have redescribed other material from Spandl's Suez Canal collection and established a neotype. Based on the four-spined distolateral crown of male gnathopod 2 and the 7-7-7-5-4-2 pleonite/urosomite formula *D.*

fresnelii is most similar to the Atlantic species *D. appendiculata* and *D. lecroyae* and the Indo Pacific species *D. cuvettensis* and *D. pacifica*.

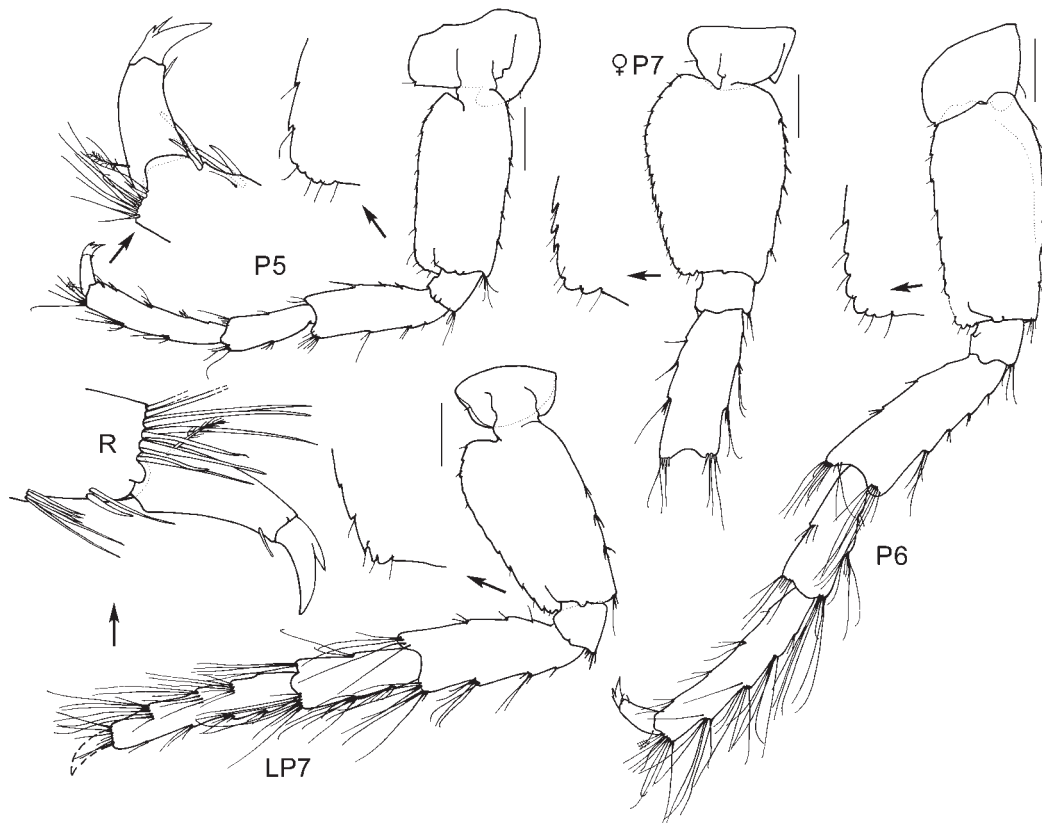


FIGURE 22. *Dulichiella fresnelii* (Audouin, 1826), neotype male, 6.6 mm, NHMW 19616, female, 6.7 mm, NHMW 20944, Little Bitter Lake, Suez Canal, Egypt. Scales represent 0.2 mm.

Dulichiella fresnelii has a slightly convex palm on the female gnathopod 2 which is similar to that of *D. appendiculata*, but the sexually dimorphic male pereopods 6 and 7 are much less setose in *D. fresnelii*. *Dulichiella lecroyae* differs mainly in the lateral cephalic lobe which is apically rounded (apically truncated in *D. fresnelii*) and the posterior margin of the female pereopod 7 basis which is convex (straight and tapering distally in *D. fresnelii*).

Dulichiella fresnelii and *D. cuvettensis* appear to be very similar. However *D. fresnelii* has only one accessory spine on the dactyli of pereopods 5 to 7 (two accessory spines in *D. cuvettensis*) and the male of *D. fresnelii* has bunches of long, slender setae on the carpus and propodus of pereopods 6 and 7 which are lacking on the pereopods of *D. cuvettensis*. *Dulichiella fresnelii* and *D. pacifica* also appear to be very similar, but *D. fresnelii* has a straight posterior margin on the basis of male pereopod 6 (concave in *D. pacifica*), and a straight posterior margin on the basis of female pereopod 7 (concave in *D. pacifica*).

Distribution. Red Sea.

***Dulichiella guinea* sp. nov.**

(Figs 23–24)

Melita fresneli. –Pirlot, 1939: 76 (unconfirmed). –Reid, 1951: 242 (part from Sierra Leone unconfirmed).

? *Dulichiella appendiculata*. –Ledoyer, 1986: 187, fig. 9 (S).

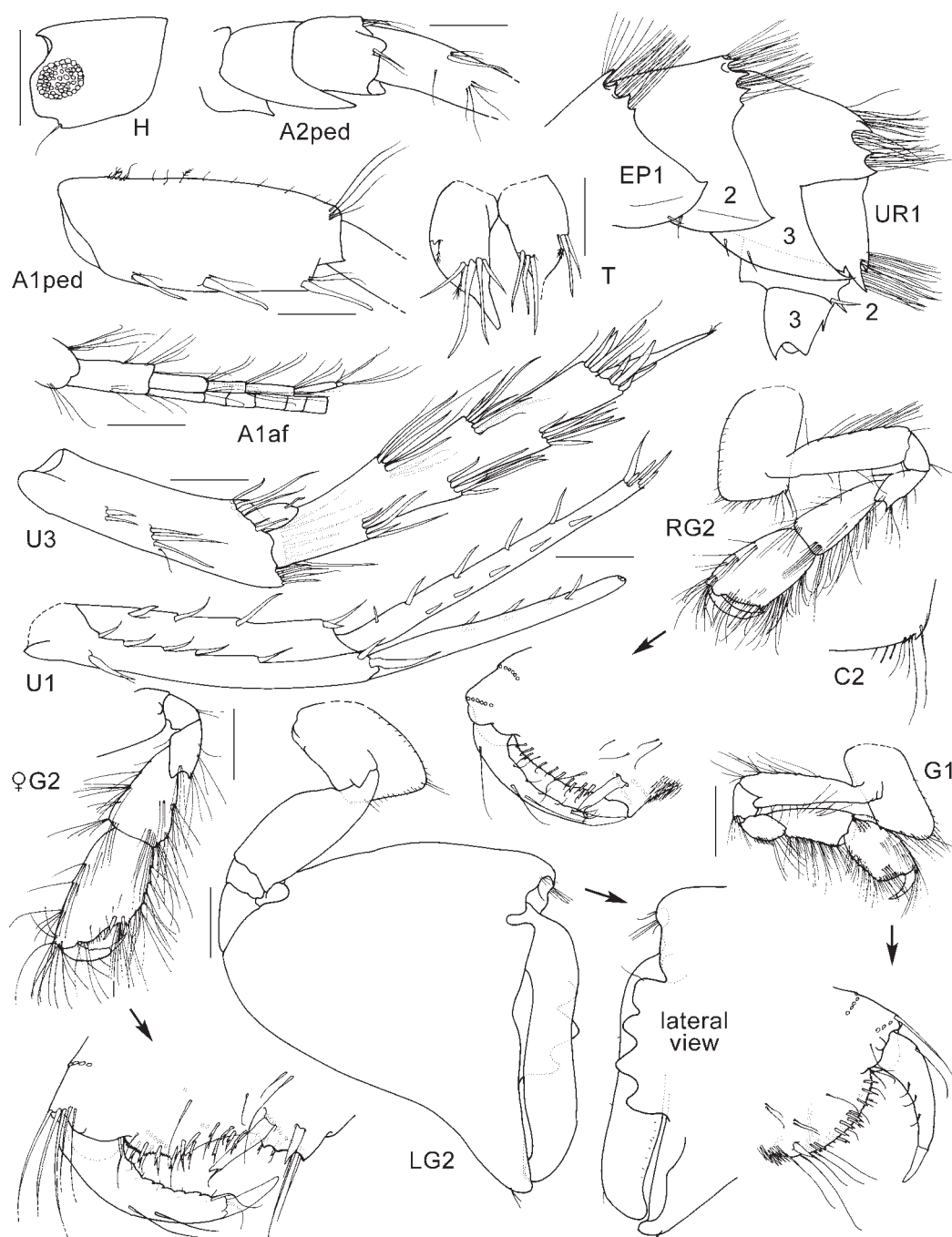


FIGURE 23. *Dulichiella guinea* **sp. nov.**, holotype male, 7.9 mm, NMS Z2006.063.0001, paratype female, 8.5 mm, NMS Z2006.063.0002, off Kaloum Peninsula, Guinea. Scales for A1, A2, U1, U3, T represent 0.2 mm, remainder represent 0.5 mm.

Type material. Holotype male, 7.9 mm, NMS Z2006.063.0001. Paratypes: 1 female, 8.5 mm, NMS Z2006.063.0002; 1 male, 8.1 mm, NMS Z 2006.063.0003; 7 specimens, NMS Z2006.063.0004, off Kaloum Peninsula, Guinea, south-eastern North Atlantic (9°20'N 14°15'W), 32 m, Atlantide Expedition, 13 April 1946, stn 145.

Type locality. Off Kaloum Peninsula, Guinea, south-eastern North Atlantic (9°20'N 14°15'W), 32 m depth.

Description. Based on holotype male, 7.9 mm, NMS Z2006.063.0001, paratype female, 8.5 mm, NMS

Z2006.063.0002 and paratype male, 8.1 mm, NMS Z2006.063.0003. Body large. **Head eyes ovate; lateral cephalic lobe broad, truncated**, anteroventral corner with slender setae. **Antenna 1 peduncular article 1** shorter than article 2, **with 3 robust setae along posterior margin**. Antenna 2 peduncular article 2 cone gland not reaching to end of peduncular article 3.

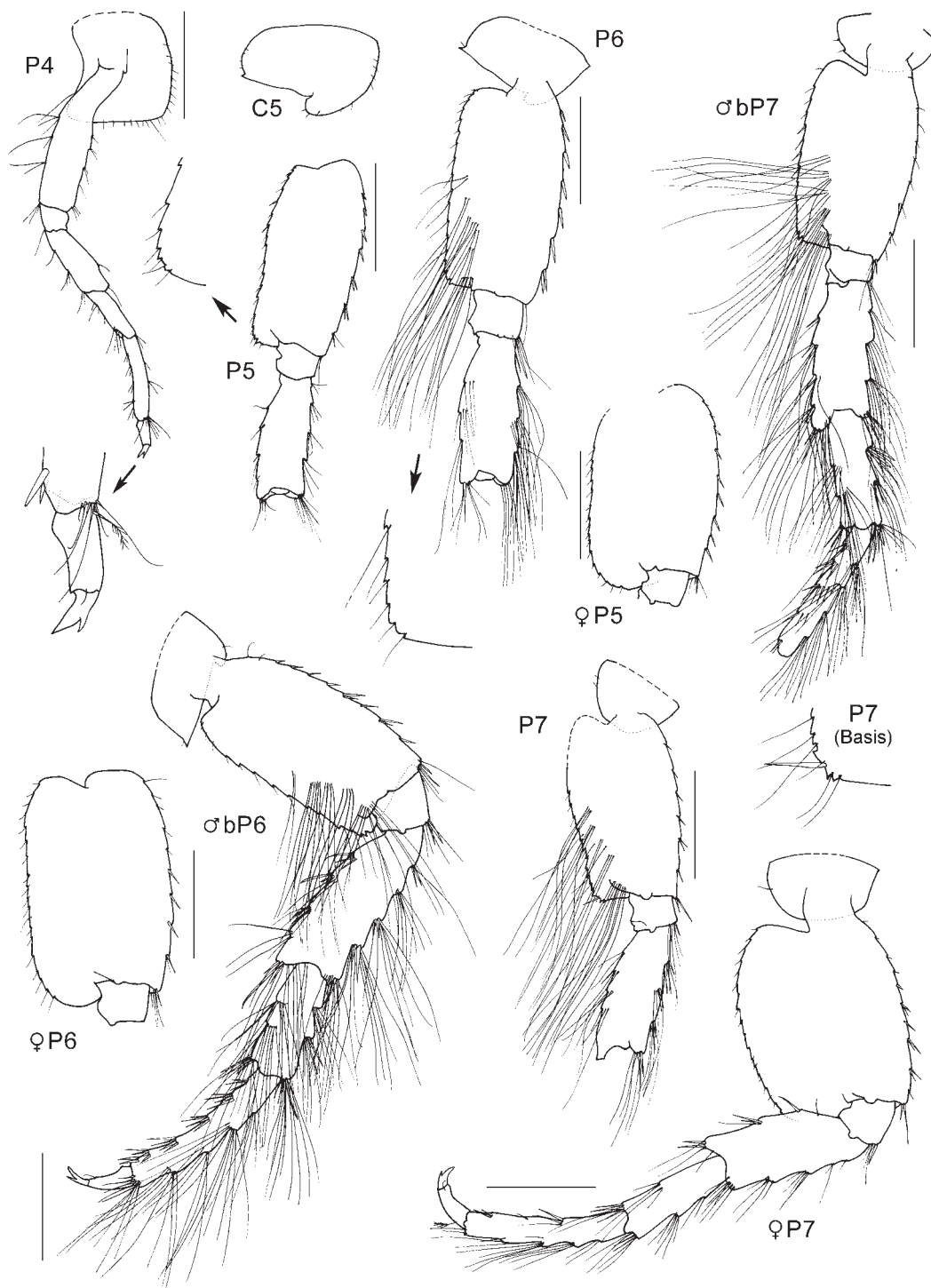


FIGURE 24. *Dulichiella guinea* **sp. nov.**, holotype male, 7.9 mm, NMS Z2006.063.0001, paratype female, 8.5 mm, NMS Z2006.063.0002, paratype male “b”, 8.1 mm, NMS Z2006.063.0003, off Kaloum Peninsula, Guinea. Scales represent 0.5 mm.

Gnathopod 1 coxa anteroventral corner not produced, anterior margin straight; carpus subequal in length to propodus; propodus small, linear, palm convex, defined by posterodistal corner, with posterodistal robust

setae. **Gnathopod 2** coxa posteroventral corner notch present (minute); (larger) **propodus distolateral crown with 4 rounded or subacute spines, fourth spine well developed**, palm sinusoidal, posterodistal corner produced, upturned, with dactylus fitting into corner; dactylus apically blunt; (smaller) merus with sharp posteroventral spine; **palm straight**, without robust setae, posterodistal corner with robust setae; dactylus with more than 2 setae on anterior margin. Pereopod 5 dactylar unguis anterior margin with accessory spine. **Pereopods 6–7 basis, merus, carpus and propodus with bunches of long slender setae.** Pereopod 6 basis posterior margin straight; dactylar unguis anterior margin with accessory spine. Pereopod 7 basis posterior margin straight.

Pleonite/urosomite dorsal spine formula (9-9-7-5-4-2). Pleonites 1–3 with dense dorsal setae. Epimeron 1 posteroventral corner with small acute or subacute spine. Epimeron 2 posteroventral corner acute. Epimeron 3 posteroventral margin smooth. Urosomite 1 with spine at midline, no conspicuous medial gape. Urosomite 2 with two groups of 1–3 small dorsolateral robust setae. Urosomite 3 without dorsal setae, with 2 dorsal spines. Uropod 3 outer ramus very long, about 2 x peduncle. Telson with dorsal robust setae.

Female (sexually dimorphic characters). Gnathopod 2 subequal in size, similar to smaller gnathopod 2 of male; palm strongly sinusoidal; dactylus crenulate. Pereopod 7 basis expanded, posterior margin convex.

Etymology. Named for Guinea in western Africa, the area where the species occurs.

Habitat. Marine epibenthic, living on sand, shell and bryozoan bottoms in 15 to 50 m depth.

Remarks. We have not seen the material reported by Pirlot (1939), but it was collected from Conakry, Guinea, western Africa, very near the type locality of *D. guinea*, and we assume it is the same species. Ledoyer (1986) reported a species of *Dulichella* from Senegal and Reid (1951) reported a species from Sierra Leone. We have not seen this material, but suspect that it might be *D. guinea*.

Dulichella guinea is perhaps the most distinctive species in the genus. It belongs with those species which have 9 dorsal spines on the pleosome segments. This includes the eastern Pacific species *D. spinosa* and the western Atlantic species *D. anisochir* and *D. terminos*. It is distinguished from these species and in fact all species of *Dulichella* by the dense rows of dorsal setae on the pleosome and all species but *D. appendiculata* by the long slender setae on the basis, merus, carpus and propodus of male pereopod 7.

Distribution. Western Africa. ? Senegal (Ledoyer, 1986); ? Sierra Leone (Reid, 1951); Guinea, (Pirlot, 1939; Reid, 1951).

***Dulichella lecroyae* sp. nov.**

(Figs 25–28)

Melita fresnelii. –Kunkel, 1910: 31, fig. 11.

Melita fresnelii. –Pearse, 1912: 371 (LeCroy, pers. comm., “all of the material that I actually looked at that Pearse had identified as *M. fresnelii* was *D. sp. A. [D. lecroyae]*. However, there were some lots (*Fish Hawk* Sta. 7431; Florida Bay stations collected on Jan 29, 1903) that I didn't run across.”).

Dulichella sp. A LeCroy, 2000: 78, fig. 126.

Type material. Holotype male, 8.1 mm, USNM 1092321, Anclote Key, Tarpon Springs, Florida, USA (28°12'N 082°52'W), associate of sponge, *Spherospongia vesparium*, 10 m, R.B. Erdman, June 1981. Paratypes: 1 female, 8.2 mm, USNM 1092322; 48 specimens, USNM 1092323; 46 paratypes, AM P61181, same locality.

Type locality. Anclote Key, Tarpon Springs, Florida, USA (28°12'N 082°52'W).

Additional material. *Gulf of Mexico*: 110–150 specimens, USFCS *Albatross*, stn 2405. Two lots, USFCS *Albatross*, stn 2406. USFCS *Albatross*, stn 2409. Specimens, USNM Acc. #42653, about 48 m depth, USFCS *Albatross*, stn 2413, 19 March 1885. Specimens, USNM Acc. #42663, about 50 m depth, USFCS *Albatross*, stn 2369–2374, 7 February 1885.

Florida: Specimens from sponge on bridge pier, fort moat, Garden Key, Dry Tortugas, USNM Acc. #

115488, Tortugas Stn 25–31. Specimens from coral in Ft. Jefferson moat, Garden Key, Dry Tortugas, T.W. Vaughan. Specimens from south of Channel Buoy, Dry Tortugas, USNM Acc. # 84129, boat dredge, about 50 m depth, 16 August 1924, Stn 3. Specimens from White Shoals, Dry Tortugas, Waldo L. Schmidt, 19 July 1924, Tortugas Stn 12. 1 specimen, Dry Tortugas, 20 June 1931, Stn 5–31. Specimens, Dry Tortugas, 26 June 1931, Stn 12–31. 1 specimen, White Shoals, Dry Tortugas, 19 July 1924, Waldo L. Schmidt, stn 25. 1 ovigerous female, east side of Loggerhead Key, Dry Tortugas, channel haul, about 20–22 m, W.L. Schmidt, 8 August 1930. Near Key West, USNM Acc. # 125158, Ray Greenfield, 29 June 1933. Specimens, No. Knight's Key Channel, Florida Keys, USNM Acc. #42664, about 20 m, USFCS *Fish Hawk*, 29 January 1903, stn 7416. Specimens, Sannibel Island, USNM USFCS *Fish Hawk*, 1 January 1913. Specimens, about 16 km offshore from Crystal River Power Plant, Crystal Bay, Crystal River, USNM 275390, 23 February 1984, 0.5–3 m depth, Stn 11. 2 specimens (small subadult male, subadult female), Cedar Keys, USNM Acc. # 18919; February 1887. 2 specimens (male and ovigerous female), Carrabelle, Apalachicola Bay, Franklin County, USNM Acc. # 185942, 18 February 1950.

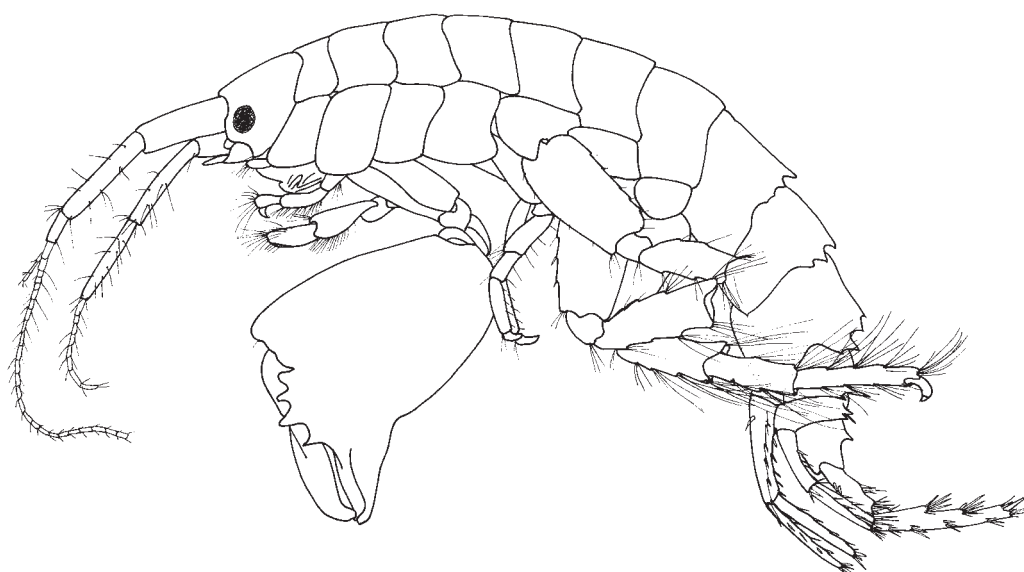


FIGURE 25. *Dulichiella lecrovayae* sp. nov., holotype male, 8.1 mm, USNM 1092321 Anclote Key, Tarpon Springs, Florida, USA.

Description. Based on holotype male, 8.1 mm, USNM 1092321, and paratype female, 8.2 mm, USNM 1092322. Body large. Head eyes ovate; lateral cephalic lobe broad, rounded, anteroventral corner with slender setae. Antenna 1 peduncular article 1 shorter than article 2, with 4 robust setae along posterior margin. Antenna 2 peduncular article 2 cone gland not reaching to end of peduncular article 3; article 4 slightly longer than article 5. Mandibular palp article 1 about as long as broad, inner margin article 1 produced distally; article 2 slightly longer than article 3.

Gnathopod 1 coxa anteroventral corner not produced, anterior margin straight, posteroventral corner notch present; carpus longer than propodus; propodus small, linear, palm convex, defined by posterodistal corner, with posterodistal robust setae. **Gnathopod 2** coxa posteroventral corner notch present; (larger) **propodus distolateral crown with 4 rounded or subacute spines, fourth spine well developed**, posterodistal corner produced, upturned, dactylus fitting into corner; dactylus apically hooked; (smaller) merus with sharp posteroventral spine; palm straight, without robust setae, posterodistal corner with robust setae; dactylus with more than 2 setae on anterior margin. Pereopod 5 dactylar unguis anterior margin with accessory spine. **Pereopods 6–7 carpus and propodus with bunches of long slender setae.** Pereopod 6 basis posterior margin straight; dactylar unguis anterior margin with accessory spine. Pereopod 7 basis posterior margin straight.

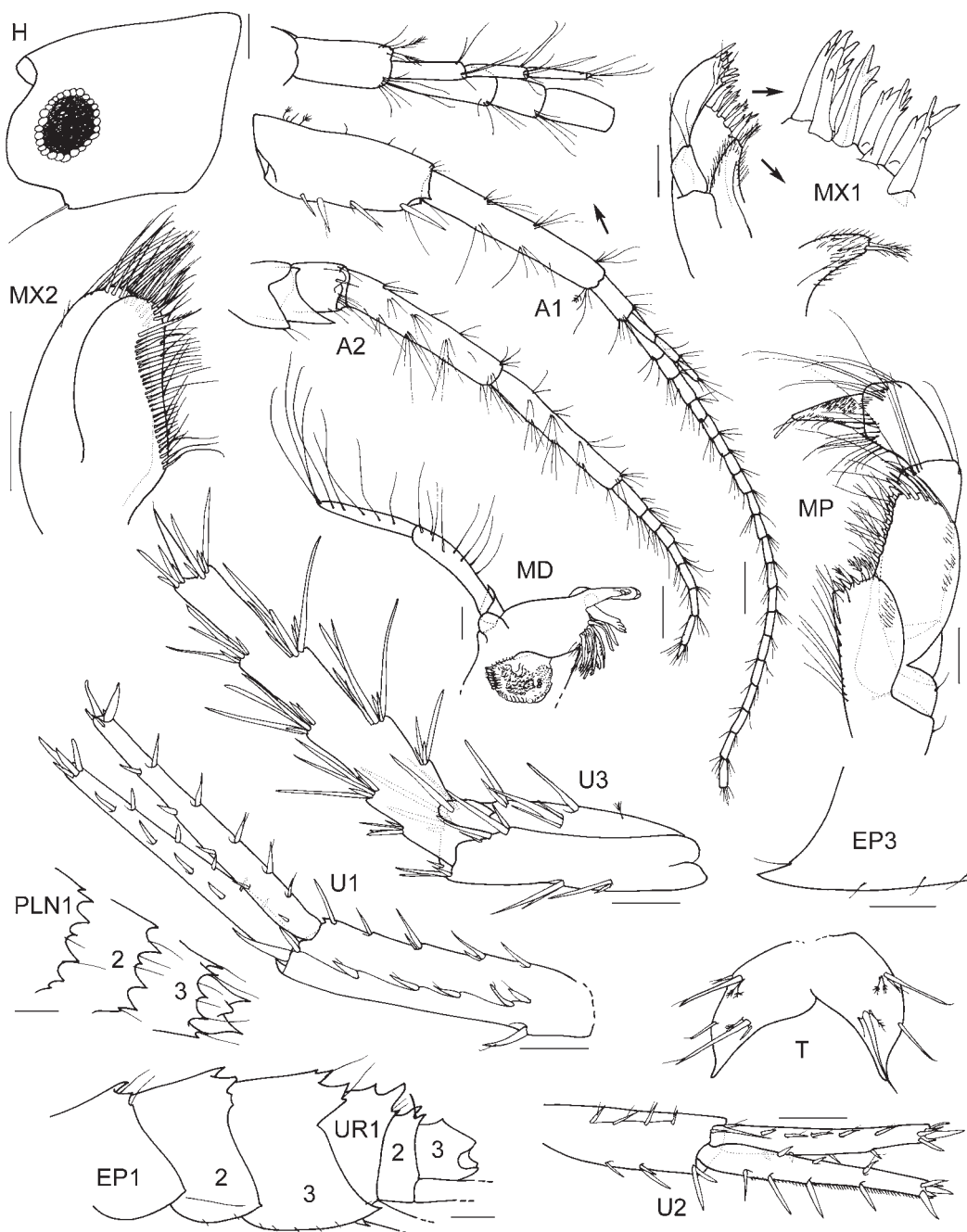


FIGURE 26. *Dulichiella lecrovae* **sp. nov.**, holotype male, 8.1 mm, USNM 1092321 Anclote Key, Tarpon Springs, Florida, USA. Scales for MD, MX1, MX2 and MP represent 0.1 mm, remainder represent 0.2 mm.

Pleonite/urosomite dorsal spine formula (7-7-7-5-4-2). Pleonites 1–3 with sparse dorsal setae. **Epimeron 1 posteroventral corner subquadrate.** Epimeron 2 posteroventral corner acute. Epimeron 3 posteroventral margin smooth. Urosomite 1 with spine at midline, no conspicuous medial gape. Urosomite 2 with two groups of 1–3 small dorsolateral robust setae. Urosomite 3 without dorsal setae; with 2 dorsal spines. Uropod 3 outer ramus very long, about 2 x peduncle. Telson with dorsal robust setae.

Female (sexually dimorphic characters). Gnathopod 2 subequal in size, similar to smaller gnathopod 2 of male; palm strongly concave; dactylus crenulate. Pereopod 7 basis expanded, posterior margin convex and tapering distally.

Etymology. Named for Sara LeCroy who first recognised this species and made it available to us for study.

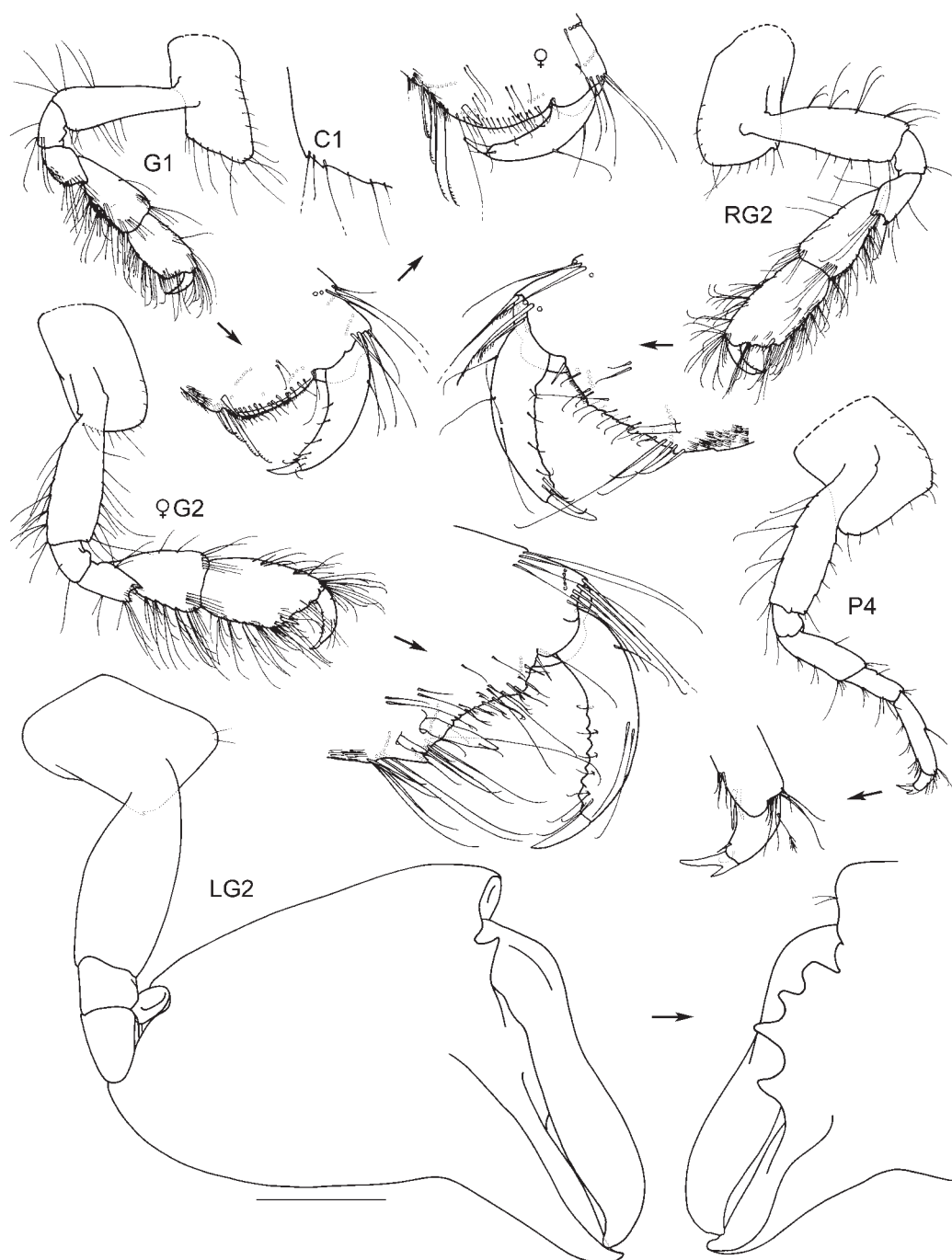


FIGURE 27. *Dulichiella lecrovae* **sp. nov.**, holotype male, 8.1 mm, USNM 1092321; paratype female, 8.2 mm, USNM 1092322, Anclote Key, Tarpon Springs, Florida, USA. Scales represent 0.2 mm.

Habitat. Marine epibenthic, associated with the sponge *Spheciospongia vesparium* at Tarpon Springs and generally in live bottom habitats elsewhere (LeCroy, *in litt.*).

Remarks. *Dulichiella lecrovae* has four spines on the distolateral crown of male gnathopod 2 and a 7-7-7-5-4 pleonite/urosomite formula. Five other species share these characters: *D. appendiculata*; *D. cuvetensis*; *D. fresnelii*; *D. guinea* and *D. pacifica*.

The geographic distribution of *Dulichiella lecrovae* overlaps with *D. appendiculata* in Florida. The two species can be distinguished from each other by the shape of the lateral cephalic lobe, rounded in *D. lecrovae* and truncated in *D. appendiculata*; in the shape of the female gnathopod 2 palm, concave in *D. lecrovae* and

convex in *D. appendiculata*; the posterior margin of the dactylus, serrate in *D. lecroyae* and smooth in *D. appendiculata*; in the dactyli of the pereopods which have two accessory spines in *D. appendiculata* (one in *D. lecroyae*); the presence of bunches of long slender setae on the basis and merus of pereopods 6 and 7 in *D. appendiculata* (absent in *D. lecroyae*); and in the posteroventral corners of epimera 1 and 2 which have small acutely produced corners in *D. appendiculata* (subquadrate in *D. lecroyae*).

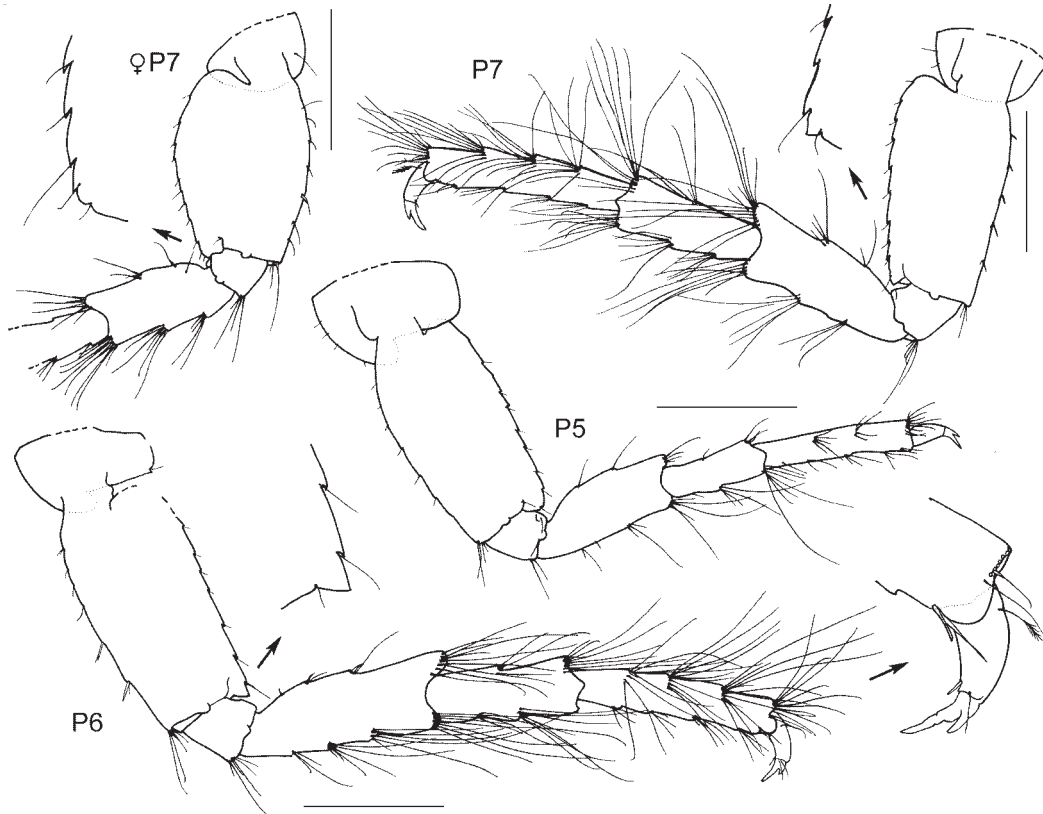


FIGURE 28. *Dulichiella lecroyae* sp. nov., holotype male, 8.1 mm, USNM 1092321; paratype female, 8.2 mm, USNM 1092322, Anclote Key, Tarpon Springs, Florida, USA. Scales represent 0.2 mm.

Dulichiella lecroyae is very similar to the Red Sea species *D. fresnelii*. The main character which separates these two species is the lateral cephalic lobe which is apically rounded in *D. lecroyae* and apically truncated in *D. fresnelii*. *Dulichiella lecroyae* also differs in the convex posterior margin on the basis of female pereopod 7 (straight and tapering distally in *D. fresnelii*). *Dulichiella lecroyae* differs from the Indian Ocean species *D. cuvettensis* in having one accessory spine on the dactyli of pereopods 5 to 7 (two accessory spines in *D. cuvettensis*) and in having bunches of long, slender setae on the carpus and propodus of male pereopods 6 and 7 (absent in *D. cuvettensis*). *Dulichiella lecroyae* differs from the South Pacific species, *D. pacifica*, in the female gnathopod 2 which has a shorter carpus and propodus and a crenulate posterior margin on the dactylus (smooth in *D. pacifica*). In addition the posterior margin of the basis of pereopod 6 is straight in *D. lecroyae* and concave in *D. pacifica*.

The distribution records from this species are based mainly on LeCroy (2000) and LeCroy (*in litt.*).

Distribution. Bermuda (Kunkel, 1910). USA. *South Carolina*: Sewee Bay (SERTC). *Georgia*: from Florida Bay to Perdido Key (LeCroy, 2000). *Florida*: Dry Tortugas; Key West; No. Knight's Key Channel; Sannibel Island; Crystal Bay; Cedar Keys; Apalachicola Bay; (all USNM). Gulf of Mexico (USNM).

***Dulichchiella oahu* sp. nov.**

(Fig. 29)

Melita fresneli. –J.L. Barnard, 1955: 13.

Melita appendiculata. –J.L. Barnard, 1970: 161, figs 101–102. –J.L. Barnard, 1971: 85. –Barnard & Barnard, 1983: 247, fig. 45A.

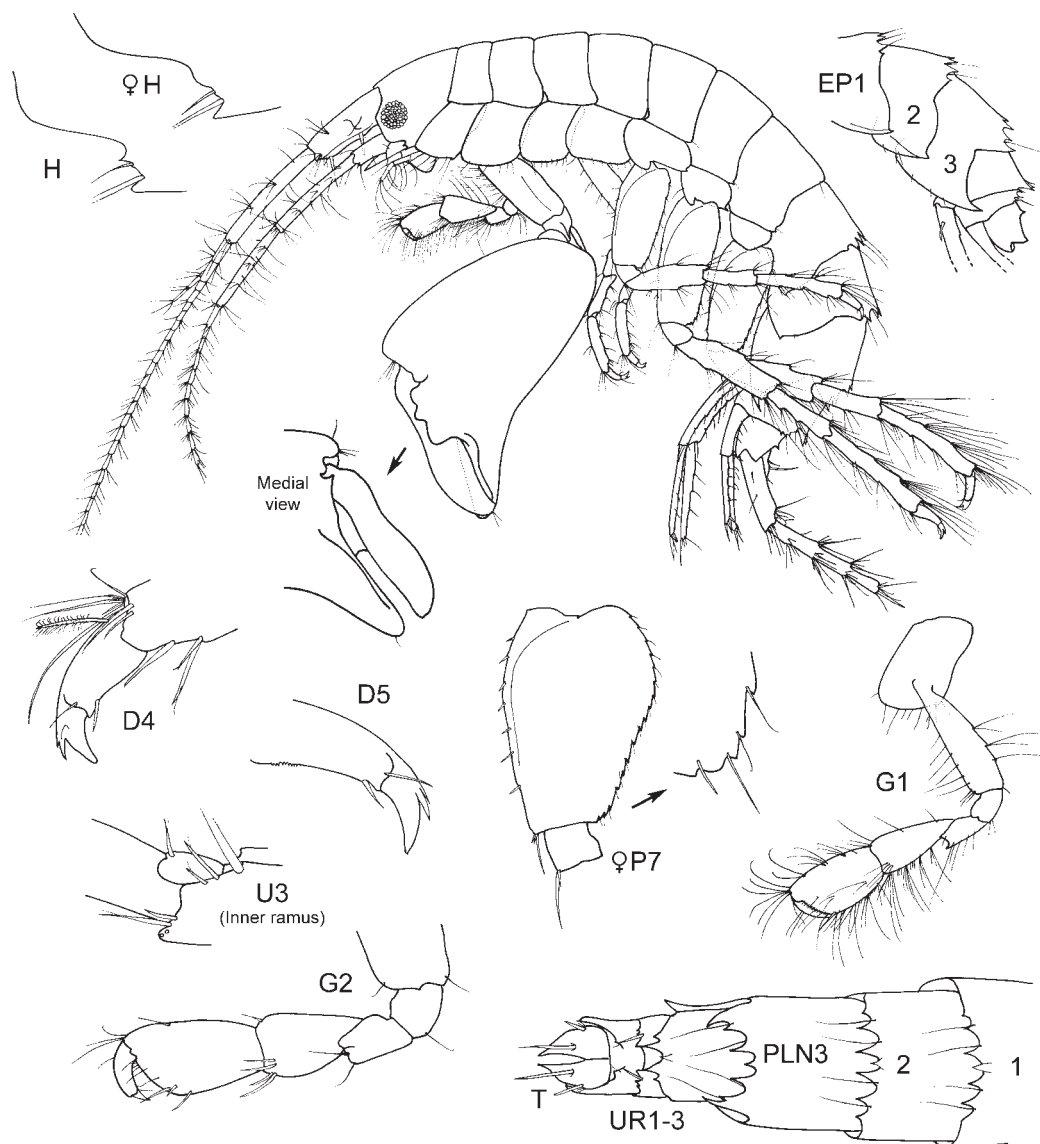


FIGURE 29. *Dulichchiella oahu*, **sp. nov.**, holotype male, 4.8 mm, USNM 151369, female, 4.7 mm, off Barbers Point, Oahu, Hawaii. (After J.L. Barnard, 1970: figs 101–102).

Type material. Holotype male, 4.8 mm, USNM 151369, off Barbers Point, Oahu, Hawaii, 30 m, wash of numerous coralline balls, J.L. Barnard, 29 January 1967.

Type locality. Off Barbers Point, Oahu, Hawaiian Islands, among dead coralline algae, 30 m depth.

Description. Based on J.L. Barnard, 1970: 161, figs 101–102. Body small. Head eyes round; lateral cephalic lobe broad, truncated, anteroventral corner with slender setae. **Antenna 1 peduncular article 1** shorter than article 2, **with 2 robust setae along posterior margin**. Antenna 2 peduncular article 2 cone gland reaching at least to end of peduncular article 3; article 4 longer than article 5. Mandibular palp unknown.

Gnathopod 1 coxa anteroventral corner not produced, anterior margin straight, posteroventral corner notch present; carpus subequal in length to propodus; propodus small, linear, palm defined by posterodistal

corner. **Gnathopod 2** coxa posteroventral corner notch present; (larger) **propodus distolateral crown with 3 rounded indistinct spines**, palm straight, posterodistal corner produced, straight, with dactylus fitting into corner; dactylus apically blunt; (smaller) merus with sharp posteroventral spine; palm convex, with robust setae; dactylus with 1 or 2 setae on anterior margin. Pereopod 5 dactylar unguis anterior margin with 2 accessory spines. Pereopods 6–7 carpus and propodus with bunches of long slender setae. **Pereopod 6** basis posterior margin straight; **dactylar unguis anterior margin with 2 accessory spines**. Pereopod 7 basis posterior margin straight.

Pleonite/urosomite dorsal spine formula (7-7-7-5-6-2). Pleonites 1–3 with sparse dorsal setae. Epimeron 1 posteroventral corner with small acute or subacute spine. Epimeron 2 posteroventral corner acute. Epimeron 3 posteroventral margin smooth. Urosomite 1 with spine at midline, no conspicuous medial gape. Urosomite 2 with two groups of 1–3 small dorsolateral robust setae. Urosomite 3 with two groups of small dorsal setae, with 2 dorsal spines. Uropod 3 outer ramus very long, about 2 x peduncle. Telson with dorsal robust setae.

Female (sexually dimorphic characters). Gnathopod 2 subequal in size, similar to smaller gnathopod 2 of male; palm slightly convex; dactylus posterior margin smooth. Pereopod 7 basis expanded, posterior margin convex and tapering distally.

Etymology. Named for Oahu in Hawaii.

Habitat. Marine epibenthic, living among corals, coralline algae and fleshy algae between 3 to 30 m depth.

Remarks. According to J.L. Barnard (1970) there were three specimens in the original series. None of these specimens is lodged in the Bishop Museum (Lu Eldredge, *in litt.*). One specimen from this collection is lodged in the National Museum of Natural History (Elizabeth Harrison-Nelson, *in litt.*) and this specimen is designated as the holotype. The other two specimens appear to be lost.

Dulichchiella oahu is most similar to *D. australis* and *D. tulear*. The main differences between *D. oahu* and *D. australis* are antenna 1 peduncular article 1 with two robust setae in *D. oahu* and four robust setae in *D. australis* and the pereopodal dactyli which have two accessory spines in *D. oahu* and one accessory spine in *D. australis*. *Dulichchiella oahu* differs from *D. tulear* in the pereopodal dactyli, which have two accessory spines in *D. oahu* and one in *D. tulear* and in the posteroventral margin of epimeron 3 which is smooth in *D. oahu* and minutely serrate in *D. tulear*.

Distribution. USA. *Hawaii*: off Ewa Beach, Oahu; off Barbers Point, Oahu; Kaneohe Bay, Oahu (J.L. Barnard, 1970).

***Dulichchiella pacifica* Lowry & Springthorpe, 2005**

(Figs 30–32)

Dulichchiella appendiculata. –Ledoyer, 1986: 187, fig. 9 N Cal. –Berents, 1983: 111, fig. 9.

Dulichchiella pacifica. –Lowry & Springthorpe, 2005: 292, figs 54–57.

Type material. Holotype male, 4.4 mm, AM P61112, between Tandai Point and Koilo Point, Guadalcanal, Solomon Islands (09°22.5'S 159°52.2'E), coral rubble, 10 m, R.T. Springthorpe, 24 September 1991, SI–3. Paratypes: 1 female, 5.9 mm, AM P61113, same as type locality; 9 specimens (1 male, 5 ovigerous females, 3 non-ovigerous females), AM P61117, same as type locality; 1 male "b", 4.1 mm, AM P61114; 4 males, AM P61115, Tandai Point, Guadalcanal, Solomon Islands, 9°23'S 159°52.5'E, sand with low algal turf, 20 m, hand dredge, R.T. Springthorpe, 11 October 2001, SI–36; 1 male, AM P61116, same locality, black finger sponges from rubble bottom, 16 m, R.T. Springthorpe, 11 October 2001, SI–38.

Type locality. Coral rubble between Tandai Point and Koilo Point, Guadalcanal, Solomon Islands (9°22.5'S 159° 52.2'E).

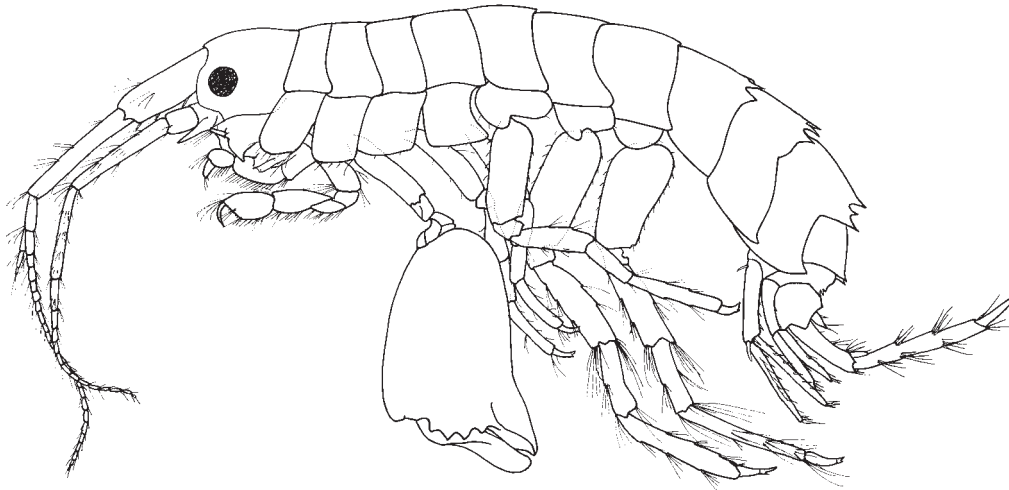


FIGURE 30. *Dulichiella pacifica* Lowry & Springthorpe, 2005, paratype male "b", 4.1 mm, AM P61114, Tandai Point, Guadalcanal, Solomon Islands. (After Lowry & Springthorpe, 2005: fig. 54).

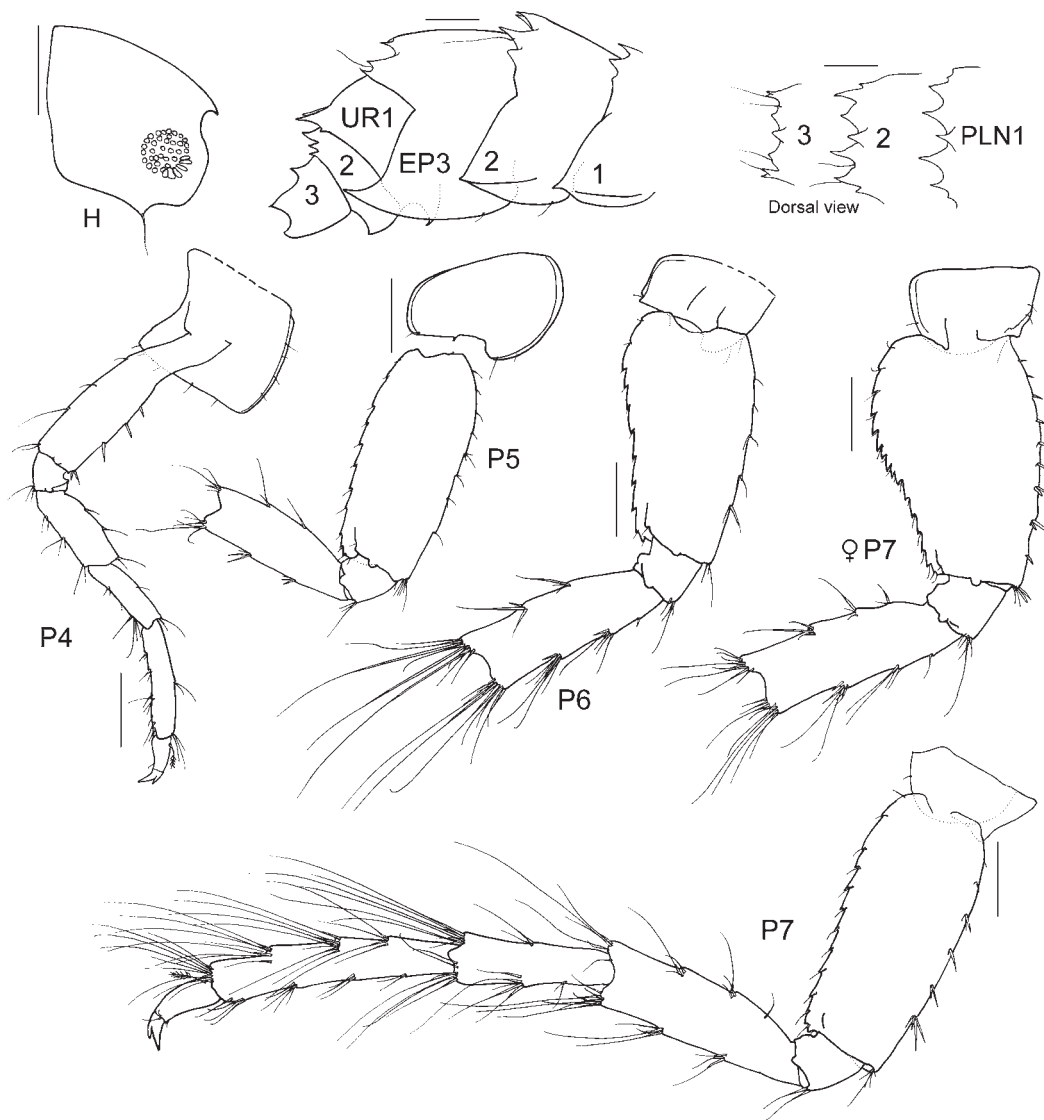


FIGURE 31. *Dulichiella pacifica* Lowry & Springthorpe, 2005, holotype male "a", 4.4 mm, AM P61112, paratype female, 5.9 mm, AM P61113, Tandai Point, Guadalcanal, Solomon Islands. Scales represent 0.2 mm. (After Lowry & Springthorpe, 2005: figs 55, 57).

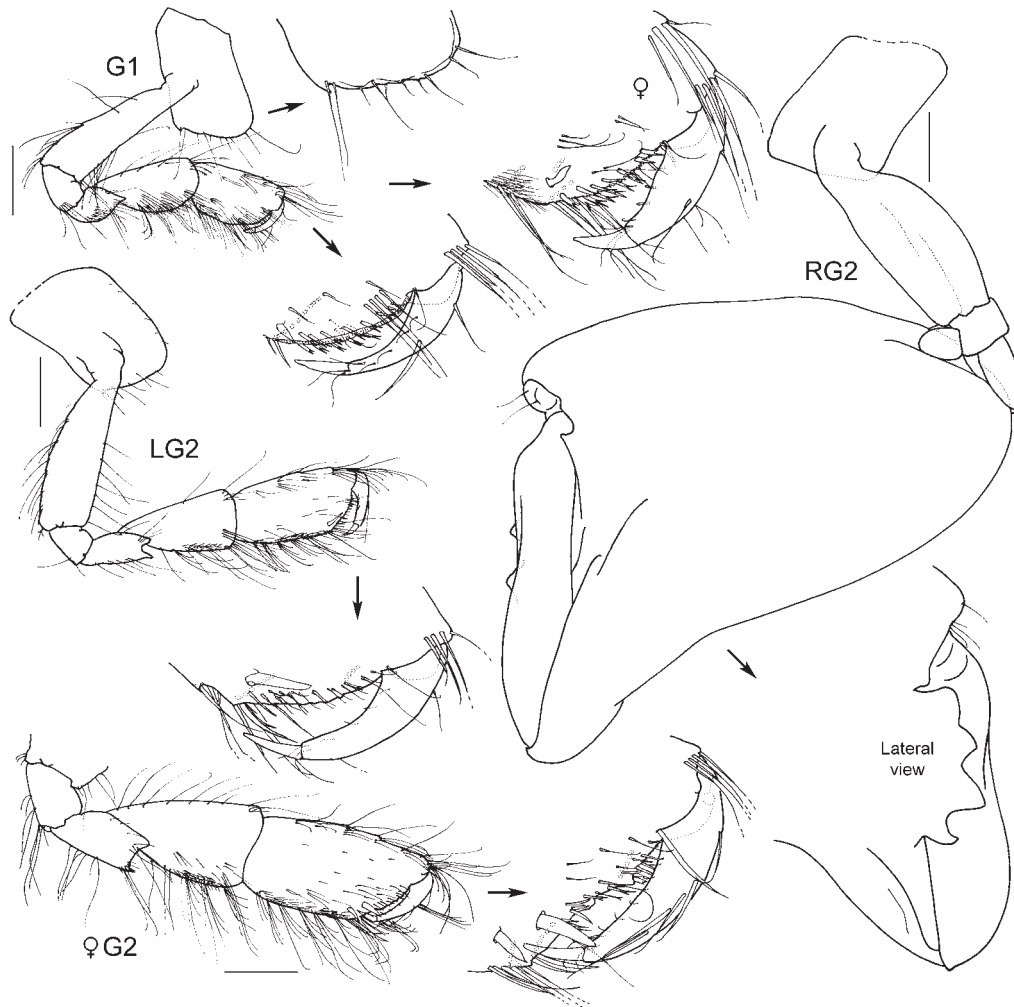


FIGURE 32. *Dulichiella pacifica* Lowry & Springthorpe, 2005, holotype male "a", 4.4 mm, AM P61112, paratype female, 5.9 mm, AM P61113, Tandai Point, Guadalcanal, Solomon Islands. Scales represent 0.2 mm. (After Lowry & Springthorpe, 2005: fig. 56).

Description. Based on holotype male "a", AM P61112, paratype female, AM P61113, and paratype male "b", AM P61114. Body small. Head eyes round; lateral cephalic lobe broad, truncated, anteroventral corner with slender seta. **Antenna 1 peduncular article 1** shorter than article 2, **with 3 robust setae along posterior margin**. Antenna 2 peduncular article 2 cone gland reaching at least to end of peduncular article 3; article 4 subequal to article 5. Mandibular palp article 1 about as long as broad, inner margin produced distally; article 2 subequal to article 3.

Gnathopod 1 coxa anteroventral corner not produced, anterior margin straight, posteroventral corner notch present; carpus subequal in length to propodus; propodus small, linear, **palm convex, without posterodistal corner**, with posterodistal robust setae. **Gnathopod 2** coxa posteroventral corner notch present; (larger) **propodus distolateral crown with 4 rounded or subacute spines, fourth spine well developed**, palm straight, posterodistal corner produced, upturned, dactylus fitting into corner; dactylus apically blunt; (smaller) merus with sharp posteroventral spine; palm convex, without robust setae, posterodistal corner with robust setae; dactylus with 1 or 2 setae on anterior margin. Pereopod 5 dactylar unguis anterior margin with accessory spine. **Pereopods 6–7 carpus and propodus with bunches of long slender setae. Pereopod 6 basis posterior margin slightly concave**; dactylar unguis anterior margin with one accessory spine. **Pereopod 7 basis posterior margin straight.**

Pleonite/urosomite dorsal spine formula (7-7-7-5-4/6-2). Pleonites 1–3 with sparse dorsal setae. **Epimeron 1 posteroventral corner with small acute spine.** Epimeron 2 posteroventral corner acute. Epimeron 3 posteroventral margin smooth. Urosomite 1 with 5 dorsal spines. Urosomite 2 with two groups of 1–3 small dorsolateral robust setae. Urosomite 3 without dorsal setae, with 2 dorsal spines. Uropod 3 outer ramus very long, about 2 x peduncle. Telson with dorsal robust setae.

Female (sexually dimorphic characters). Gnathopod 2 subequal in size, similar to smaller gnathopod 2 of male; palm concave; dactylus posterior margin smooth, with 5 setae on anterior margin. Pereopod 7 basis expanded, posterior margin convex and tapering distally.

Habitat. Marine epibenthic, living among coral rubble, sponges, sand and low algal turf in 10 to 20 m depth.

Remarks. *Dulichchiella pacifica* has four spines on the distolateral crown of male gnathopod 2 and a 7-7-7-5-4/6-2 pleonite/urosomite formula. Four other species share these characters: *D. appendiculata*; *D. fresnelii*; *D. lecrovayae*; and *D. cuvettensis*.

Dulichchiella pacifica is most similar to *D. cuvettensis* and *D. fresnelii*. It differs from *D. cuvettensis* in having one accessory spine on the dactyli of pereopods 5 to 7 (two accessory spines in *D. cuvettensis*) and in having bunches of long, slender setae on the carpus and propodus of male pereopods 6 and 7 which are absent in *D. cuvettensis*. The corner of male gnathopod 1 palm is rounded in *D. pacifica* and subquadrate in *D. cuvettensis*.

Dulichchiella pacifica differs from *D. fresnelii* in the posterior margin of the basis of pereopod 6 which is concave in *D. pacifica* and straight in *D. fresnelii* and in the posterior margin of the basis of pereopod 7 which is straight in *D. pacifica* and tapering distally in *D. fresnelii*.

Dulichchiella pacifica differs from *D. appendiculata* in the much less setose male pereopods 6 and 7 and in having a single accessory spine on the dactyli of the pereopods (*D. appendiculata* has two spines). *Dulichchiella pacifica* differs from *D. lecrovayae* in the female gnathopod 2 which has a longer carpus and propodus and a smooth posterior margin on the dactylus (crenulate posterior margin in *D. lecrovayae*). In addition the posterior margin of the basis of pereopod 6 is concave in *D. pacifica* and straight in *D. lecrovayae*.

Dulichchiella pacifica is a common shallow-water species in Singapore, New Guinea, New Caledonia, the Solomon Islands and north-eastern Australia. J.L. Barnard (1965) did not report a species of *Dulichchiella* from Micronesia and Myers (1985) did not report a *Dulichchiella* from Fiji.

Distribution. Australia. *Queensland*: Yonge Reef; Lizard Island; Great Barrier Reef. Singapore. New Guinea. Madang Lagoon. Solomon Islands. Guadalcanal. New Caledonia: Poé Plage; Thio; South-east Lagoon (all Lowry & Springthorpe, 2005).

***Dulichchiella spinosa* Stout, 1912**

(Figs 33–35)

Dulichchiella spinosa Stout, 1912: 141, figs 179–180. –Karaman & Barnard, 1979: 153. –Barnard & Barnard, 1983: 668. –

Jarrett & Bousfield, 1996: 13 (unconfirmed).

Melita fresnelii. –Shoemaker, 1941: 187. –Hewatt, 1946: 202 (unconfirmed).

Melita appendiculata. –J.L. Barnard, 1969: 126 (unconfirmed).

Type material. Neotype adult male, 7.3 mm, LACMNH CR1990-360.1, off Pt Vicente, Palos Verdes Peninsula, California, USA, (33°44'38"N 118°25'05"W), red algae, otter trawl, 27 m, Don Cadien, 9 May 1990.

Type locality. Living on red algae off Palos Verdes, California in about 27 m depth.

Additional material. Female, 12.5 mm, LACMNH CR1990.360.2. 73 specimens, LACMNH CR 1990-360.3. 5 males, 5 females, AM P69771, same locality.

Description. Based on neotype male, 7.3 mm, LACMNH CR1990-360.1 and female, 12.5 mm, LAC-

MNH CR1990.360.2. Body large. Head eyes round; lateral cephalic lobe broad, truncated, anteroventral corner with slender setae. Antenna 1 peduncular article 1 shorter than article 2, with 3 robust setae along posterior margin. Antenna 2 peduncular article 2 cone gland not reaching to end of peduncular article 3; article 4 subequal to article 5. Mandibular palp article 1 about as long as broad, inner margin article 1 produced distally; article 2 shorter than article 3.

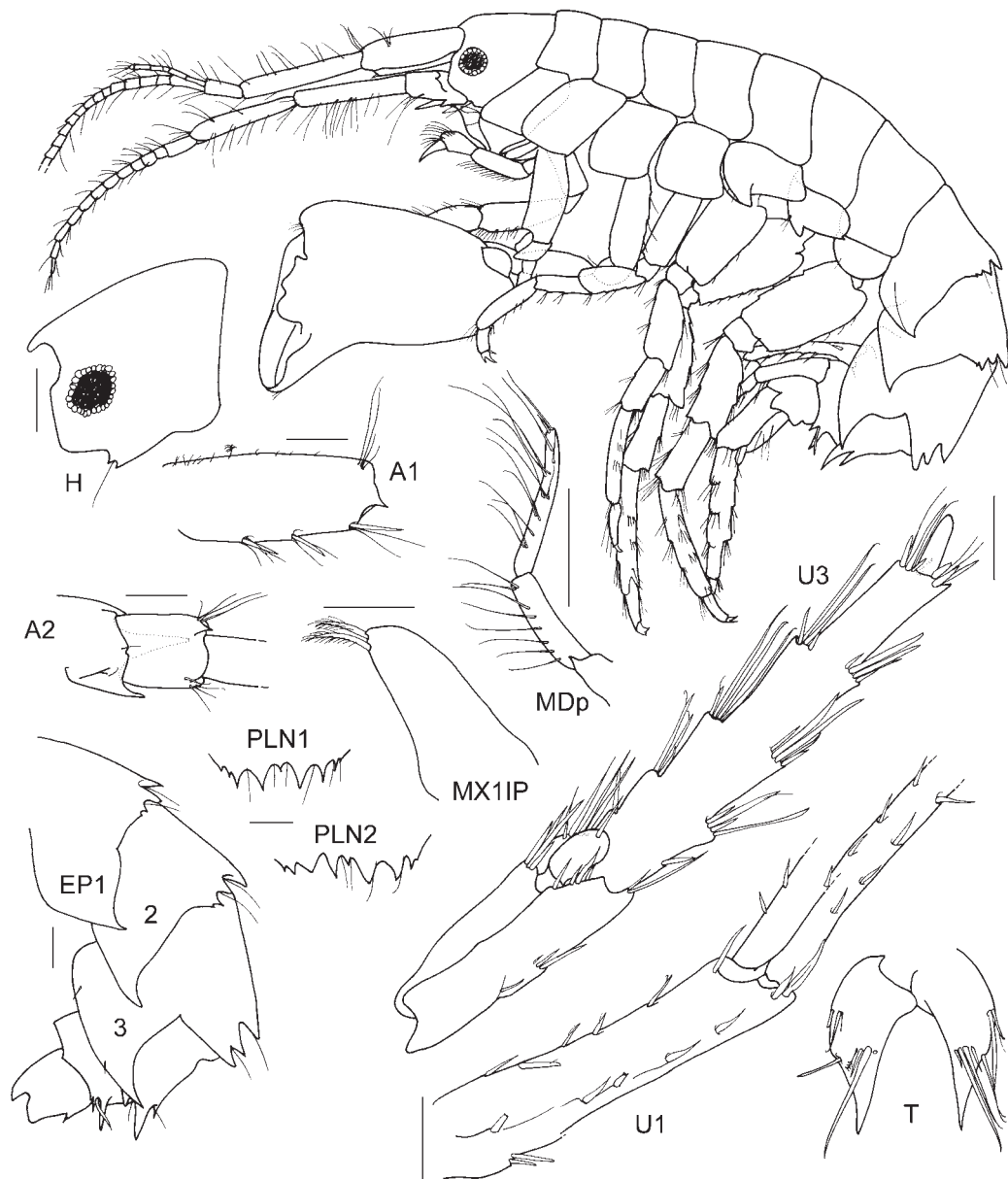


FIGURE 33. *Dulichiella spinosa* Stout, 1912, neotype male, 7.3 mm, LACMNH CR1990-360.1, off Pt Vicente, Palos Verdes Peninsula, California, USA. Scale for MX1IP represents 0.1 mm, remainder represent 0.2 mm.

Gnathopod 1 coxa anteroventral corner not produced, anterior margin straight, posteroventral corner notch present (minute); palm straight, defined by posterodistal corner, with posterodistal robust setae. **Gnathopod 2** coxa posteroventral corner notch absent; (larger) **propodus distolateral crown with 3 rounded indistinct spines**, palm sinusoidal, posterodistal corner produced, bilobed, dactylus fitting against corner; dactylus apically blunt; (smaller) merus with sharp posteroventral spine; palm straight, without robust setae, posterodistal corner with robust setae; dactylus with more than 2 setae on anterior margin. Pereopod 5 dactylar unguis anterior margin with accessory spine. Pereopods 6–7 basis, merus, carpus and propodus without

bunches of long slender setae. Pereopod 6 basis posterior margin straight; dactylar unguis anterior margin with accessory spine. **Pereopod 7 basis posterior margin convex.**

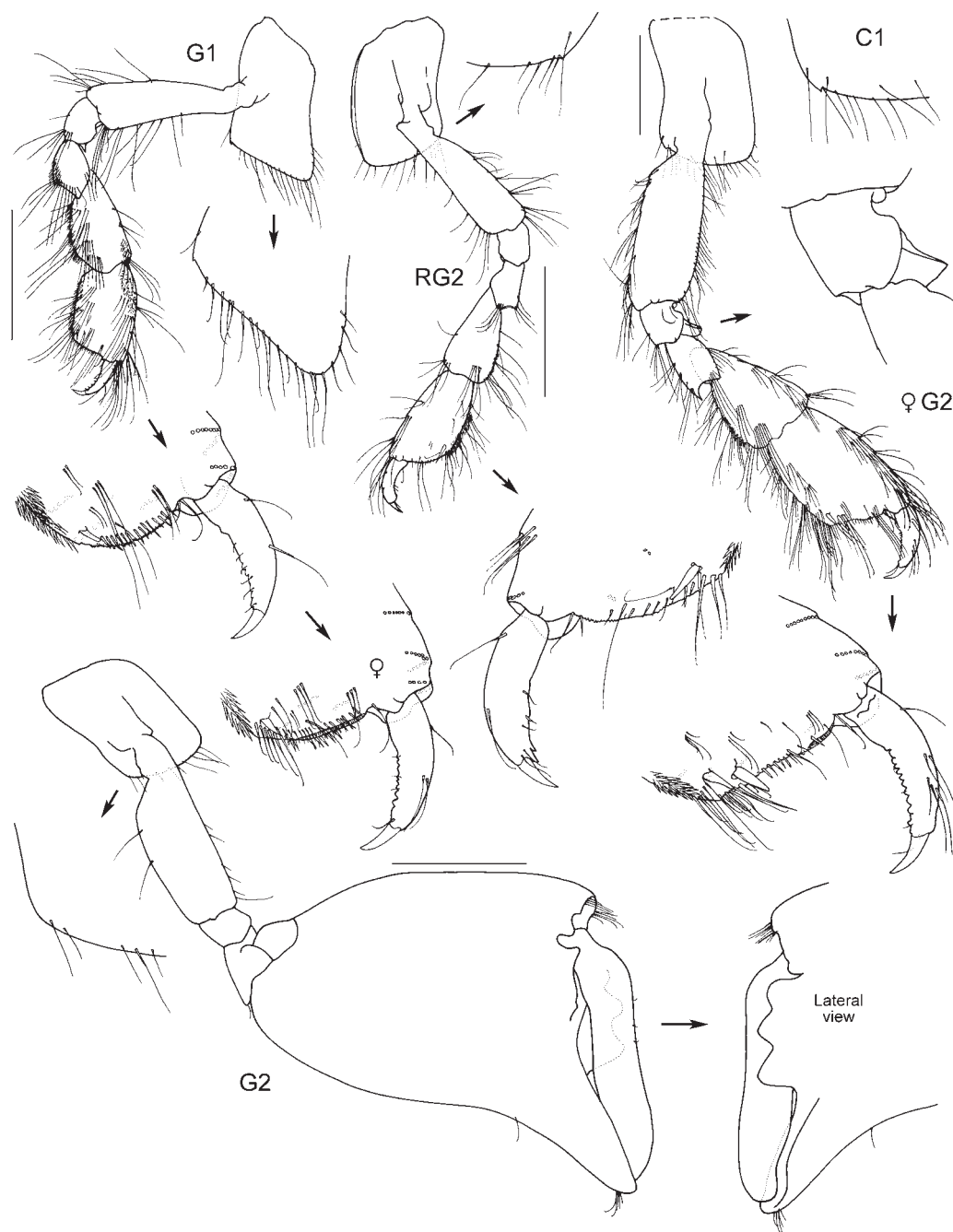


FIGURE 34. *Dulichiella spinosa* Stout, 1912, neotype male, 7.3 mm, LACMNH CR1990-360.1, female, 12.5 mm, LACMNH CR1990.360.2, off Pt Vicente, Palos Verdes Peninsula, California, USA. Scales represent 0.5 mm.

Pleonite/urossomite dorsal spine formula (9-9-7-5-4-2). Pleonites 1–3 with sparse dorsal setae. Epimeron 1 posteroventral corner with small acute or subacute spine. Epimeron 2 posteroventral corner acute. Epimeron 3 posteroventral margin smooth. Urossomite 1 with spine at midline, no conspicuous medial gape. Urossomite 2 with two groups of 1–3 small dorsolateral robust setae. Urossomite 3 without dorsal setae; with 2 dorsal spines. Uropod 3 outer ramus very long, about 2 x peduncle. Telson with dorsal robust setae.

Female (sexually dimorphic characters). Gnathopod 2 subequal in size, similar to smaller gnathopod 2 of male; palm slightly sinusoidal; dactylus posterior margin crenulate. Pereopod 7 basis expanded, posterior

margin convex and tapering distally.

Habitat. Marine epibenthic, living among kelp holdfasts and red algae, sublittoral to at least 30 m depth.

Remarks. Shoemaker (1941) indicated that the material used by Stout (1912) was lost. He obtained fresh collections from Laguna Beach, California and re-identified Stout's (1912) amphipods, including *D. spinosa*, which he referred to as *D. fresnelii*. J.L. Barnard (1969: 3) clearly stated that "Stout's types, in the defunct Laguna Marine Laboratory of Pomona College, have been lost". Further enquiries to Joel Martin and George Davis at the Los Angeles County Museum of Natural History indicated that no type material of *D. spinosa* was lodged there. Fortunately we were able to obtain new material of *D. spinosa* collected by Don Cadien (Marine Biology Lab, Los Angeles County Sanitation Department) from off Palos Verdes, California, near the type locality.

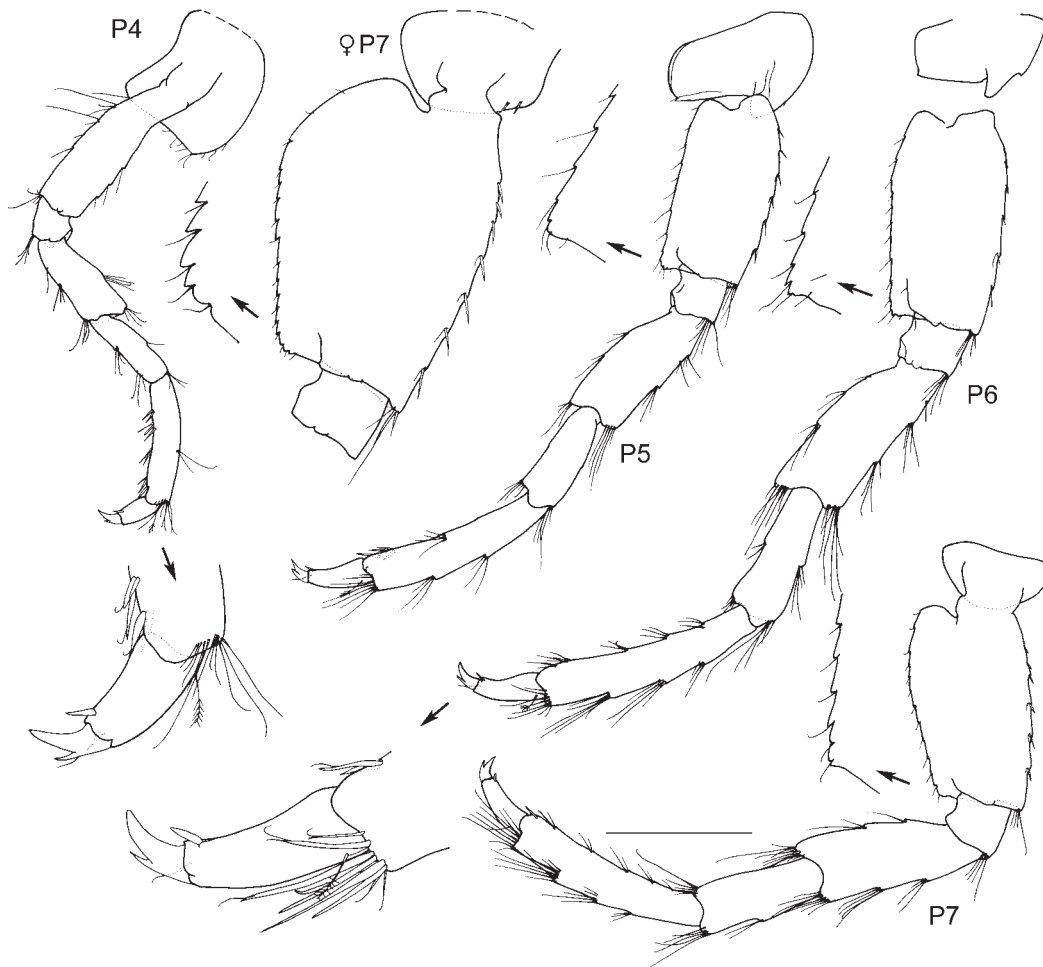


FIGURE 35. *Dulichiella spinosa* Stout, 1912, neotype male, 7.3 mm, LACMNH CR1990-360.1, female, 12.5 mm, LACMNH CR1990.360.2, off Pt Vicente, Palos Verdes Peninsula, California, USA. Scale represents 0.5 mm.

Although *Dulichiella spinosa* is the type species of the genus it has always been obscure. The original description of Stout (1912) is inadequate and there has never been a redescription. Subsequent identifications of the species (Shoemaker, 1941; J.L. Barnard, 1969; Jarrett & Bousfield, 1996) have been confused. J.L. Barnard (1969) reported new material, as *M. appendiculata* from Goleta, California, but with no evidence for the species identification. Jarrett & Bousfield (1996) indicated that they had seen material of *D. spinosa* from central "California northwards", but they give no detailed locality information and no evidence for their identification. Both records (J.L. Barnard, 1969; Jarrett & Bousfield, 1996) need confirmation.

For these reasons we have selected a neotype for the species. The redescription presented here, based on new material from near the original type locality, allows us to compare *D. spinosa* with other species in the genus.

Dulichchiella spinosa has 9 dorsal spines each on the first two segment of the pleosome, in common with three Atlantic Ocean species: *D. anisochir* from Brazil, *D. guinea* from Guinea, and *D. terminos* from the Gulf of Mexico. *Dulichchiella spinosa* is easily distinguished from *D. terminos* by the blunt spines on the distolateral crown of the large male gnathopod 2. *Dulichchiella spinosa* is very similar to *D. anisochir*. Both have three blunt spines on the distolateral crown of the larger male gnathopod 2 and neither has well developed bunches of long setae on pereopods 6 and 7. *Dulichchiella spinosa* differs from *D. anisochir* in the produced anteroventral corner of coxa 1 (not produced in *D. anisochir*) and in the smooth posteroventral margin of epimeron 3 (minutely crenulate in *D. anisochir*). *Dulichchiella spinosa* differs from *D. guinea* in the shape of the palm of female gnathopod 2, straight in *D. spinosa* and excavate in *D. guinea*; in the sparsely setose dorsal pleosome of *D. spinosa* and male pereopods 6–7 (all densely setose in *D. guinea*).

Distribution. USA. *California*: Laguna Beach (Stout, 1912); Palos Verdes; Goleta (J.L. Barnard, 1969).

***Dulichchiella terminos* sp. nov.**

(Fig. 36)

Dulichchiella appendiculata. –Ledoyer, 1986: 185, figs 8–9.

Type material. Holotype male, 6 mm, Estero Pargo, Laguna de Términos, Campeche Bay, Mexico, Gulf of Mexico, stn 17 (illustrated by Ledoyer, 1986, whereabouts of specimen not known, probably no longer extant).

Type locality. Estero Pargo, Laguna de Términos, Campeche Bay, Mexico, Gulf of Mexico.

Additional material. 1 female, Estero Pargo, Laguna de Términos, Campeche Bay, Mexico, Gulf of Mexico, stn 16. 4 males, 2 females and 1 juvenile, same as type locality.

Description. Based on Ledoyer, 1986: 185, fig. 8. Body large. Head eyes round; lateral cephalic lobe broad, truncated, anteroventral corner rounded (no apparent seta). Antenna 1 peduncular article 1 shorter than article 2, with 3 robust setae along posterior margin. Antenna 2 peduncular article 2 cone gland reaching at least to end of peduncular article 3; article 4 subequal to article 5. Mandibular palp article 1 about as long as broad, inner margin article 1 not produced distally; article 2 subequal to article 3.

Gnathopod 1 coxa anteroventral corner not produced, anterior margin straight, posteroventral corner notch present; carpus longer than propodus; propodus small, linear, palm shape unknown, defined by posterodistal corner. **Gnathopod 2** coxa posteroventral corner notch present; (larger) propodus **distolateral crown with 3 acute distinct spines**, palm sinusoidal, produced, posterodistal corner upturned, posterodistal corner with dactylus fitting into corner; dactylus apically hooked; (smaller) merus with rounded posteroventral corner; palm convex, with robust setae; dactylus with 1 or 2 setae on anterior margin. Pereopods 6–7 merus, carpus and propodus unknown. Pereopod 6 basis posterior margin straight; dactylar unguis anterior margin with accessory spine.

Pleonite/urosomite dorsal spine formula (9-9-9-5-6-2). Pleonites 1–3 with sparse dorsal setae. Epimeron 3 posteroventral margin smooth. Urosomite 1 with spine at midline, no conspicuous medial gape. Urosomite 2 with two groups of 1–3 small dorsolateral robust setae. Urosomite 3 without dorsal setae; with 2 dorsal spines. Uropod 3 outer ramus very long, much longer than peduncle. Telson with dorsal robust setae.

Etymology. Named for the type locality, Laguna de Términos.

Habitat. Marine epibenthic, *Thalassia* beds in less than 10 m depth.

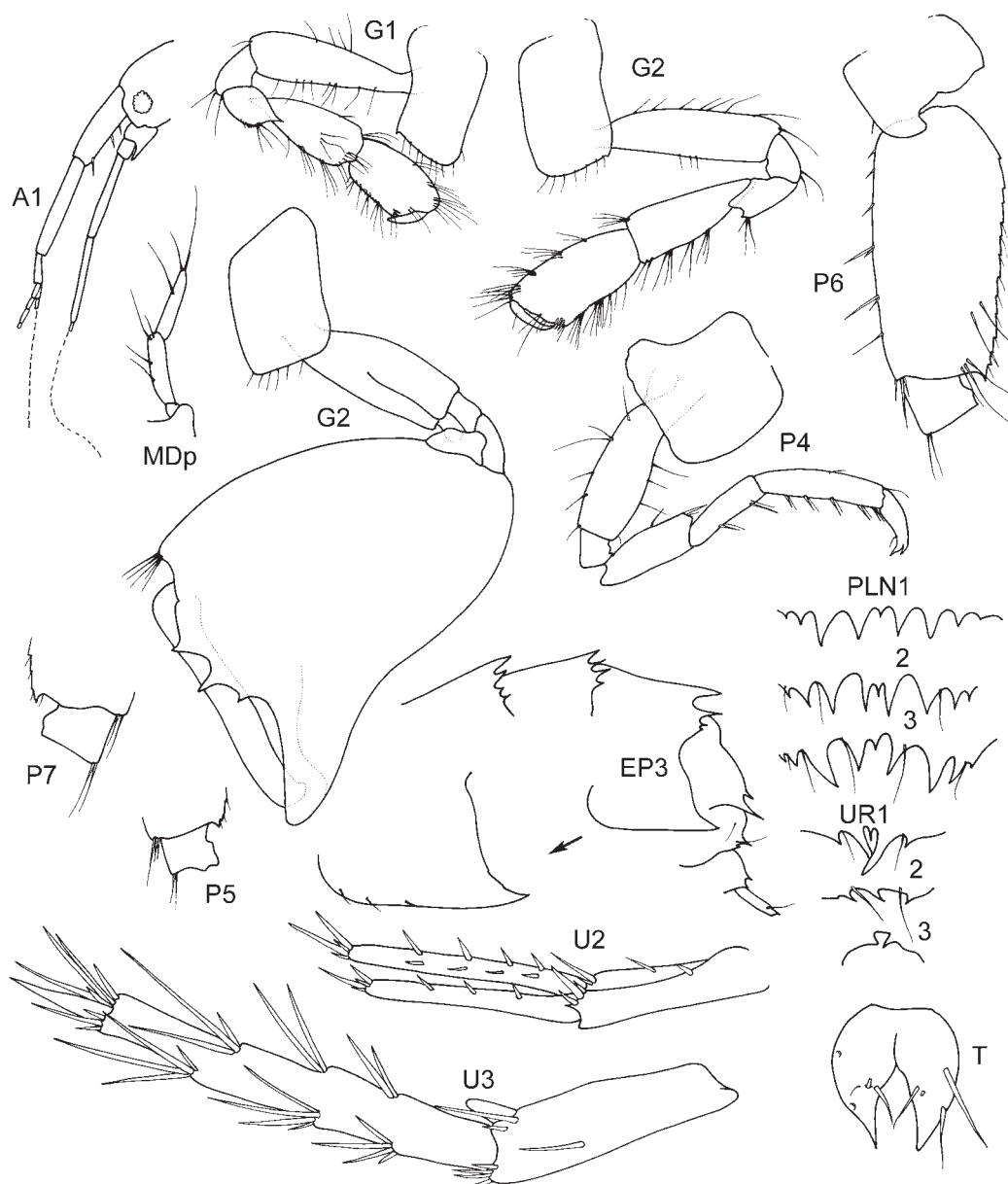


FIGURE 36. *Dulichiella terminos* **sp. nov.**, holotype male, 6 mm, Laguna de Términos, Gulf of Mexico, Mexico. (After Ledoyer, 1986: figs 8–9).

Remarks. Unfortunately no specimens of this species could be located. In accordance with ICZN Articles 72.5.6 and 73.1.4, we have designated the male illustrated by Ledoyer (1986) as the holotype. We have enquired in the Muséum National d'Histoire Naturelle, Paris, in the Museo Civico di Storia Naturale, Verona and the Station Marine D'endoume Marseille, the places where the majority of Ledoyer's collections are housed and the material is not there. *Dulichiella terminos* is not as well known as other species and the specimens on which the species is based are lost. The female is not described. The mouthparts are not known except the mandible and the pereopods are unknown except the basis of pereopod 6. Nonetheless the acute spines on the distolateral crown of the large male gnathopod 2 distinguish *D. terminos* from all other species in the genus. Apparently the anteroventral margin of the head in *D. terminos* has no slender setae. If this is true then it is another autapomorphy defining the species.

Dulichiella terminos shares a very similar pleosome/urosome spine formula (9-9-9-5-4/6-2) with the eastern Pacific and southern Atlantic species, *D. anisochir*, *D. guinea* and *D. spinosa*.

Distribution. Mexico. Laguna de Términos, Campeche Bay, Mexico, Gulf of Mexico (Ledoyer, 1986).

***Dulichhiella tomioka* sp. nov.**
(Figs 37–38)

Melita fresneli. –Irie & Nagata, 1962: 19.

Melita fresnelii. –Nagata, 1964: 9.

Melita appendiculata. –Hirayama & Kikuchi, 1979: 69, figs 2–6. –Ishimaru, 1994: 49.

Dulichhiella appendiculata. –Hirayama, 1986:35, fig. 220 (map). –Ishimaru, 1994: 49.

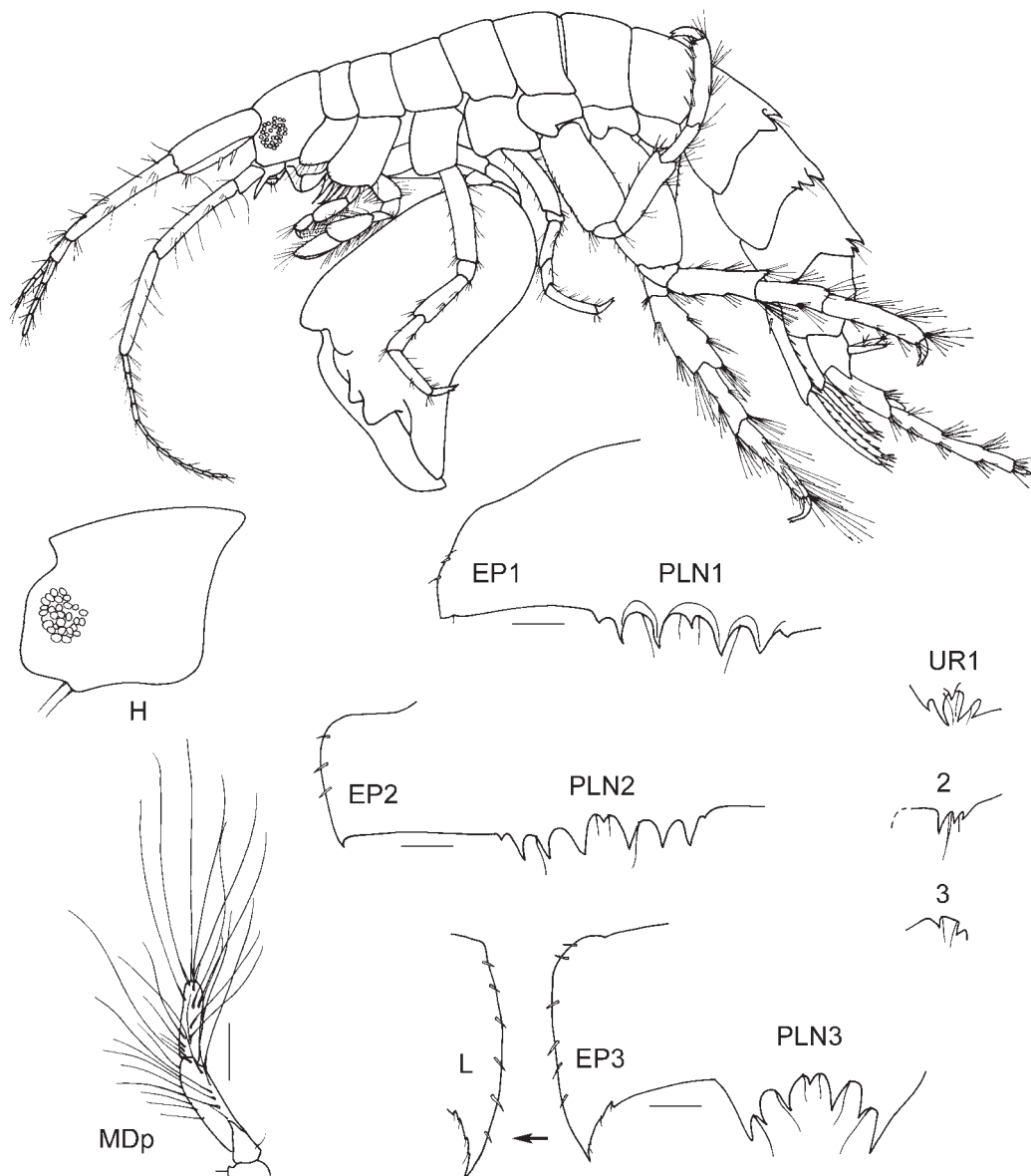


FIGURE 37. *Dulichhiella tomioka*, **sp. nov.**, holotype male 7.5 mm, AMBL Amph. 21, no. 2, off Uze, mouth of Tomioka Bay, Amakusa, Kyushu, Japan. Scale for MDp represents 0.1 mm, remainder represent 0.2 mm. (After Hirayama & Kikuchi, 1979: figs 2–3, 6).

Type material. Holotype male, AMBL Amph. 21, no. 2, 7.5 mm, off Uze, mouth of Tomioka Bay, Amakusa, Kyushu, Japan, on sand shell bottom, 45 m, T. Kikuchi. Paratypes: 3 males, AMBL Amph. 21, no. 1, 7.0 mm, no. 3, 7.0 mm, no. 4, 6.5 mm, same locality.

Type locality. Off Uze, mouth of Tomioka Bay, Amakusa, Kyushu, Japan, on sand shell bottom, 45 m

depth.

Description. Based on Hirayama & Kikuchi, 1979: 68, figs 2–6. Body large. Head eyes round; lateral cephalic lobe broad, truncated, anteroventral corner with slender setae. Antenna 1 peduncular article 1 shorter than article 2, with 3 robust setae along posterior margin. Antenna 2 peduncular article 2 cone gland not reaching to end of peduncular article 3; article 4 subequal to article 5. Mandibular palp article 1 about as long as broad, inner margin article 1 produced distally; article 2 longer than article 3.

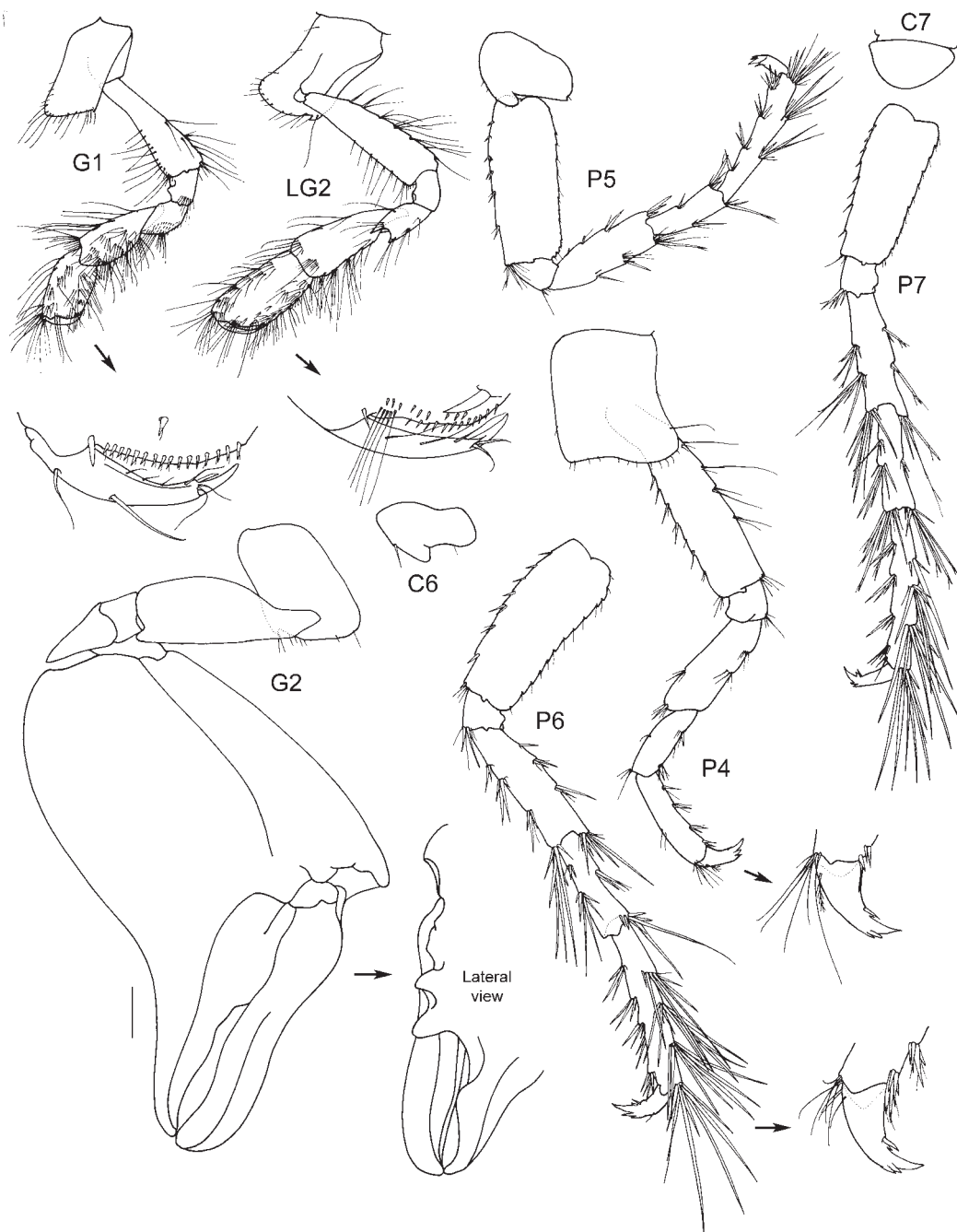


FIGURE 38. *Dulichiella tomioka*, **sp. nov.**, holotype male 7.5 mm, AMBL Amph. 21, no. 2, off Uze, mouth of Tomioka Bay, Amakusa, Kyushu, Japan. Scale represents 0.2 mm. (After Hirayama & Kikuchi, 1979: figs 4–5).

Gnathopod 1 coxa anteroventral corner not produced, anterior margin straight, posteroventral corner notch present; carpus longer than propodus; propodus small, linear, palm convex, defined by posterodistal corner, without posterodistal robust setae. **Gnathopod 2** coxa posteroventral corner notch present; (larger)

propodus distolateral crown with 2 rounded or subacute spines, palm sinusoidal, posterodistal corner produced, upturned, posterodistal corner, dactylus fitting against corner; dactylus apically blunt; (smaller) merus with sharp posteroventral spine; palm convex, without robust setae, posterodistal corner with robust setae; dactylus with 1 or 2 setae on anterior margin. Pereopod 5 dactylar unguis anterior margin with 2 accessory spines. Pereopods 6–7 carpus and propodus with bunches of long slender setae. **Pereopod 6** basis posterior margin straight; **dactylar unguis anterior margin with 2 accessory spines**. Pereopod 7 basis posterior margin straight.

Pleonite/urosomite dorsal spine formula (7-9-7-5-6-2). Pleonites 1–3 with sparse dorsal setae. Epimeron 1 posteroventral corner narrowly rounded or subquadrate. Epimeron 2 posteroventral corner acute. **Epimeron 3 posteroventral margin minutely serrate distally**. Urosomite 1 with spine at midline, no conspicuous medial gape. Urosomite 2 with two groups of 1–3 small dorsolateral robust setae. Urosomite 3 without dorsal setae; with 2 dorsal spines. Uropod 3 outer ramus very long, much longer than peduncle. Telson with dorsal robust setae.

Etymology. Named for the type locality, Tomioka Bay.

Habitat. Marine epibenthic, living on sand shell bottom at about 45 m depth.

Remarks. *Dulichhiella tomioka* and *D. cotesi* both apparently have only two spines on the distolateral crown of male gnathopod 2. *Dulichhiella tomioka* differs from *D. cotesi* in a slightly different dorsal spine formula (7-9-7-5-6-2) as opposed to (7-7-7-5-6-2 in *D. coatsi*); in the dactyli of the pereopods which have two accessory spines in *D. tomioka* (one in *D. cotesi*); and in the basis of pereopod 7 which has a straight posterior margin in *D. tomioka* (concave in *D. cotesi*).

Distribution. Japan. Tomioka Bay (Nagata, 1964).

***Dulichhiella tulear* sp. nov.**

(Fig. 39)

Melita appendiculata. –Ledoyer, 1978: 282. –Ledoyer, 1979: 86, fig. 50. –Ledoyer, 1982: 570, fig. 216.

Type material. Holotype ? subadult male, 5 mm (slide), MNHN Am3964, pente externe du Grand Récif de Tuléar, 29 m depth, Thomassin, stn 172. Paratype: 1 female (slide), MNHN Am3965, pente externe du Grand Récif de Tuléar, stn 240.

Type locality. Pente externe du Grand Récif de Tuléar, Madagascar, 29 m depth.

Description. Based on Ledoyer, 1979: 86, fig. 50 and Ledoyer, 1982: 570, fig. 216. Body small. Head eyes round; lateral cephalic lobe broad, truncated, anteroventral corner with acute/subacute spine (no apparent seta). Antenna 1 peduncular article 1 shorter than article 2. Antenna 2 peduncular article 2 cone gland reaching at least to end of peduncular article 3; article 4 subequal to article 5. Mandibular palp article 1 about as long as broad, inner margin not produced distally; article 2 subequal to article 3.

Gnathopod 1 coxa anteroventral corner not produced, anterior margin convex, posteroventral corner notch present; carpus subequal in length to propodus; propodus small, linear, palm convex, defined by posterodistal corner. **Gnathopod 2** coxa posteroventral corner notch present; (larger) **propodus distolateral crown with 3 rounded indistinct spines**, palm sinusoidal, posterodistal corner produced, straight, with dactylus fitting against corner; dactylus apically blunt; (smaller) merus with sharp posteroventral spine; palm straight, without robust setae, posterodistal corner with 1 robust seta near corner; dactylus without setae on anterior margin. Pereopod 5 dactylar unguis anterior margin with accessory spine. Pereopods 6–7 merus, carpus and propodus unknown. **Pereopod 6** basis posterior margin straight; **dactylar unguis anterior margin with accessory spine**. Pereopod 7 basis posterior margin straight.

Pleonite/urosomite dorsal spine formula (7-7-7-5-6-2). Pleonites 1–3 with sparse dorsal setae.

Epimeron 2 posteroventral corner acute. **Epimeron 3 posteroventral margin weakly serrate distally.** Urosomite 1 with spine at midline, no conspicuous medial gape. Urosomite 3 without dorsal setae; with 4 dorsal spines (not confirmed). Uropod 3 outer ramus very long, about 2 x peduncle. Telson with dorsal robust setae.

Etymology. Named for the type locality, Grand Récif de Tuléar.

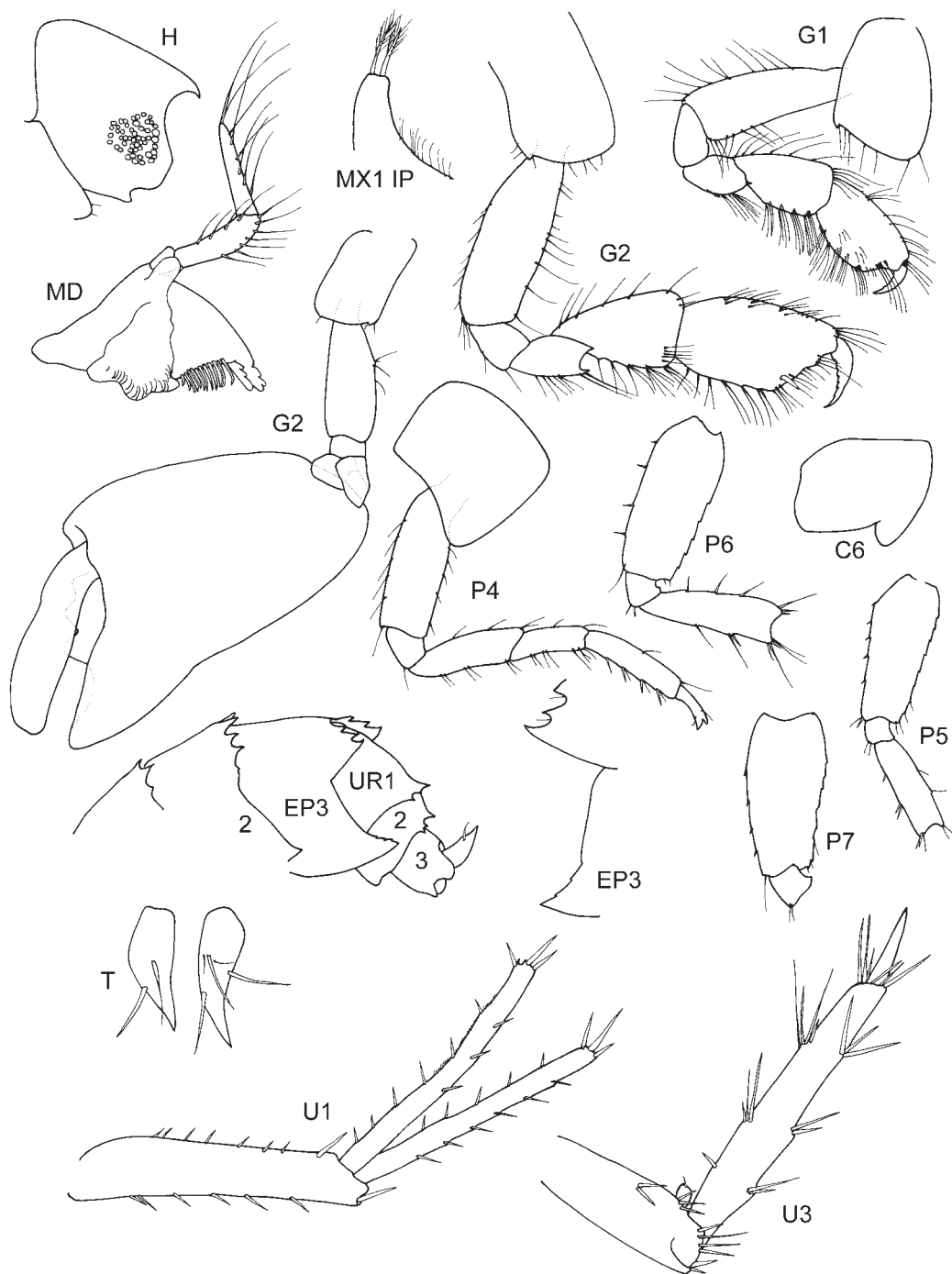


FIGURE 39. *Dulichiella tulear* sp. nov., holotype male, 5 mm, MNHN Am3964, pente externe du Grand Récif de Tuléar. (After Ledoyer, 1982: fig. 216).

Habitat. Marine epibenthic.

Remarks. *Dulichiella tulear* is based on the illustrations of Ledoyer (1979: fig. 50, 1982: fig. 216). The lack of setae on the posteroventral corner of the head and the lack of a basofacial seta on the peduncle of uropod 1 may be oversights. The species appears to be most similar to *D. australis* and *D. oahu*. *Dulichiella*

tulear differs from both species in the propodus of the smaller male gnathopod 2 which is more robust and in the posteroventral margin of epimeron 3 which is minutely serrate in *D. tulear* and smooth in *D. australis* and *D. oahu*.

In Ledoyer (1978, 1982) all material listed as occurring at station 122 is apparently from station 172. Ledoyer figured a male specimen from station 122, but the material examined section only mentions a male from station 172. Station 122 does not appear in the station list.

Distribution. Madagascar. Grand Récif de Tuléar (Ledoyer, 1978).

***Verdeia* gen. nov.**

Type species. *Melita subchelata* Schellenberg, 1925.

Diagnosis. Antenna 1 longer than antenna 2. Maxilla 1 inner plate long, narrow, tapering distally, with 2 well developed apical plumose setae. Maxilla 2 inner plate with oblique setal row. Gnathopod 2 male, significantly unequal in size, palm in larger acute, female equal in size. Pereopods 5–7 dactylar ungues without accessory spines. Pereopod 7 basis sexual dimorphism unknown. Pleonites dorsally serrate. Uropod 3 inner ramus scale-like; outer ramus 4 to 5 x longer than wide, 2-articulate. Telson deeply cleft, lobes tapering distally to an acute point.

Included species. *Verdeia* includes 2 species: *V. grandimana* (Chevreux, 1908) and *V. subchelata* (Schellenberg, 1925).

Remarks. *Verdeia* is part of the *Megamoera* group of melitids and appears to be a sister taxon of *Dulichchiella*. The shapes of the lateral cephalic lobes, the robust setae along the posterior margin of antenna 1 peduncular article 1, the slender mandibular palps with a long third article, the long, slender shape of the inner plates on maxilla 1, the asymmetrical and enlarged male second gnathopods, the shapes and structure of the female second gnathopods, the shape of coxae 4, the shapes of the basis of pereopods 5–7, the third uropods and the telsons are all similar.

Verdeia differs from *Dulichchiella* in not having setae on the anteroventral corner of the head, in not having posteroventral notches on the anterior coxae, in having a different structure to the distolateral crown and palm on the propodus of male gnathopod 2, in having an acute rather than obtuse palmar angle on gnathopod 2, and in not having accessory spines on the dactyli of pereopods 5–7.

***Verdeia grandimana* (Chevreux, 1908)**

(Fig. 40)

Melita grandimana Chevreux, 1908: 6, figs 3–4. –Schellenberg, 1926: 363. –Chevreux, 1935: 115, pl. 12, figs 7, 11. –J.L. Barnard, 1962: 108 (key). –Barnard & Barnard, 1983: 665.

Dulichchiella grandimana. –Karaman, 1981: 39.

Type material. Holotype male, 7 mm (dissected and mounted on five microscope slides), MOM 37 0874, 17 m depth, south-west of Santa Luzia, Cape Verde, Islands, Prince Albert I, 22 July 1901.

Type locality. South-west of Santa Luzia Island, Cape Verde Islands, eastern North Atlantic Ocean, 17 m depth.

Description. Based on Chevreux, 1908: 6, figs 3–4. Body large. Head eyes ovate to reniform; lateral cephalic lobe broad, truncated, anteroventral corner subquadrate. Antenna 1 peduncular article 1 subequal in length to article 2. Antenna 2 peduncular article 2 cone gland not reaching to end of peduncular article 3; article 4 subequal to article 5. Mandibular palp article 1 about as long as broad, inner margin article 1 not produced distally; article 2 shorter than article 3.

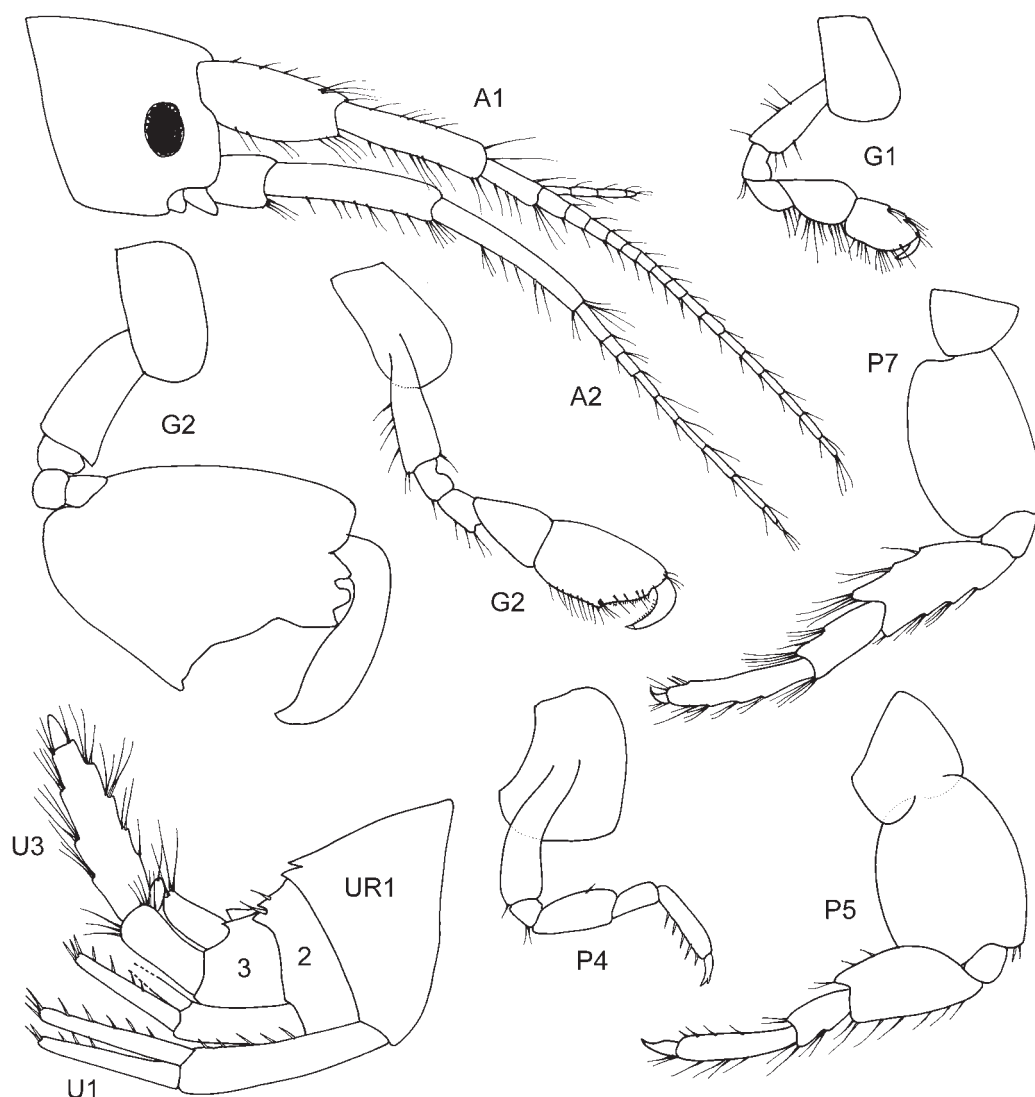


FIGURE 40. *Verdeia grandimana* (Chevreux, 1908), holotype male, 7 mm, MOM 37 0874, south-west of Santa Luzia, Cape Verde Islands. (After Chevreux, 1908: figs 3–4).

Gnathopod 1 coxa anteroventral corner not produced, anterior margin straight, not produced, posteroventral corner notch absent; carpus subequal in length to propodus; propodus "stout", palm convex, palm defined by posterodistal corner. **Gnathopod 2** coxa posteroventral corner notch absent; **propodus palm with 3 spines**, concave, posterodistal corner produced, upturned, dactylus fitting against corner; dactylus apically hooked; merus with sharp posteroventral spine; palm straight. Pereopod 5 dactylar unguis anterior margin without accessory spines. Pereopod 6 dactylar unguis anterior margin without accessory spines. Pereopod 7 basis posterior margin convex.

Pleonites 1–3 without dorsal setae. Urosomite 2 with two groups of 1–3 small dorsolateral robust setae. Urosomite 3 without dorsal setae, with 4 dorsal spines. Uropod 3 outer ramus long, about 2 x peduncle.

Habitat. Marine epibenthic.

Remarks. *Verdeia grandimana* was described from one male specimen and has not been reported since. It appears to be most similar to *V. subchelata*. In both species, the massive male second gnathopod has an acutely angled palmar margin, but the structure of the distolateral teeth is different. The main differences are that *V. grandimana* has 3 spines on the palm of male gnathopod 2 and *V. subchelata* has 2 spines.

Distribution. Cape Verde Islands, eastern North Atlantic Ocean (Chevreux, 1908).

***Verdeia subchelata* (Schellenberg, 1925)**
(Figs 41–44)

Melita fresnelii var. *subchelata* Schellenberg, 1925: 153.

Melita subchelata. –K.H. Barnard, 1932: 211, fig. 130. –J.L. Barnard, 1962: 109 (key). –Griffiths, 1975: 134. –Griffiths, 1976: 46, fig. 25f. –Barnard & Barnard, 1983: 666.

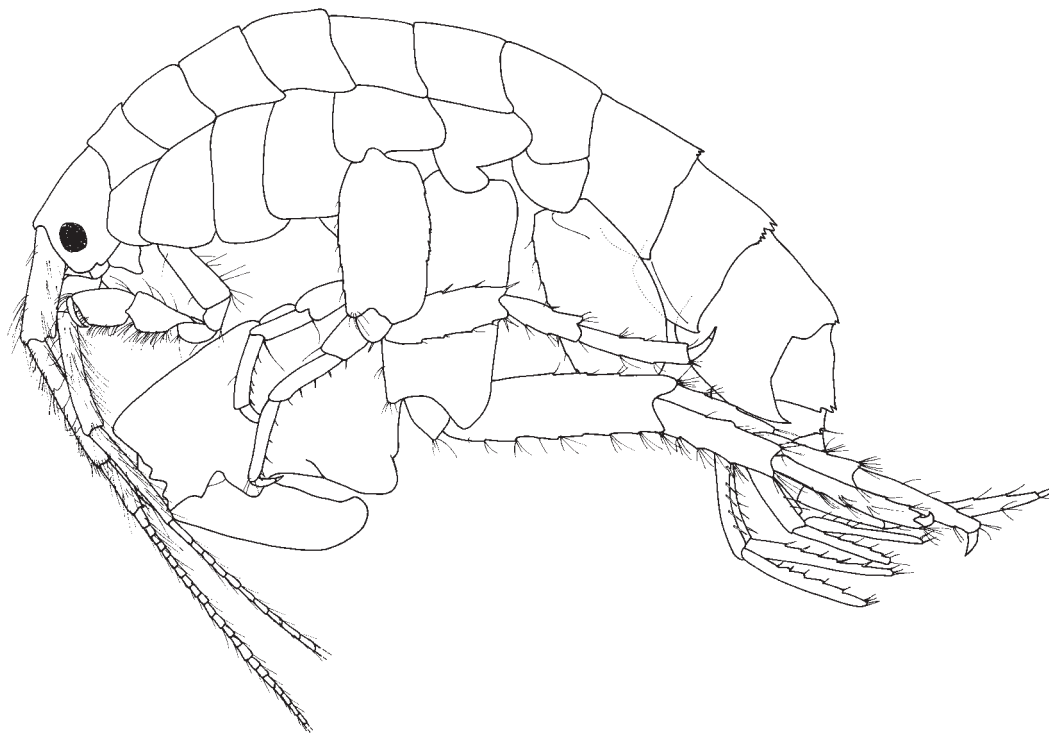


FIGURE 41. *Verdeia subchelata* (Schellenberg, 1925), male, 5.1 mm, SAM A13565, west of Saldanhabaai, South Africa.

Type material. Lectotype male, ZMB 20687. There were apparently originally four female syntypes, 5.5 to 5.8 mm, in the original type series. They were collected by the Michaelson of the Zoological Museum, Hamburg. No material is now lodged in the Zoological Museum, Hamburg and the only apparent specimen remaining in the Zoological Museum, Berlin, is the designated lectotype.

Type locality. Lüderitz, Namibia, eastern South Atlantic Ocean, 0 to 10 m depth.

Additional material examined. 1 male, 5.1 mm, 1 female, 7.8 mm, SAM A13565 (33°05'S 17°53'E), 78 m (dredge) UCT Ecological Survey, 5 May 1960, stn WCD 52 F. 4 specimens, SAM A18990 (22°53.5'S 14°27'E), 14 m (grab) UCT Ecological Survey, 9 September 1963, stn SWD 61 F.

Description. Based on 1 male, 5.1 mm, 1 female, 7.8 mm, SAM A13565. Body small. Head eyes round; lateral cephalic lobe broad, rounded, apically rounded, anteroventral corner subquadrate. Antenna 1 peduncular article 1 shorter than article 2, with 4 or more robust setae along posterior margin. Antenna 2 peduncular article 2 cone gland not reaching to end of peduncular article 3; article 4 subequal to article 5. Mandibular palp article 1 about as long as broad, inner margin article 1 not produced distally; article 2 subequal to article 3.

Gnathopod 1 coxa anteroventral corner not produced, anterior margin straight, not produced, posteroventral corner notch absent; carpus longer than propodus (slightly); propodus "stout", palm straight, palm defined by posterodistal corner, palm with posterodistal robust setae. **Gnathopod 2** coxa posteroventral corner notch absent; (larger) **propodus palm with 2 broad spines**, straight, posterodistal corner produced, straight, posterodistal corner dactylus fitting into corner; dactylus apically hooked; (smaller) merus with sharp posteroventral

spine; palm straight, lined with robust setae. Pereopod 5 dactylar unguis anterior margin without accessory spines. Pereopod 6 basis posterior margin straight; dactylar unguis anterior margin without accessory spines. Pereopod 7 basis posterior margin convex.

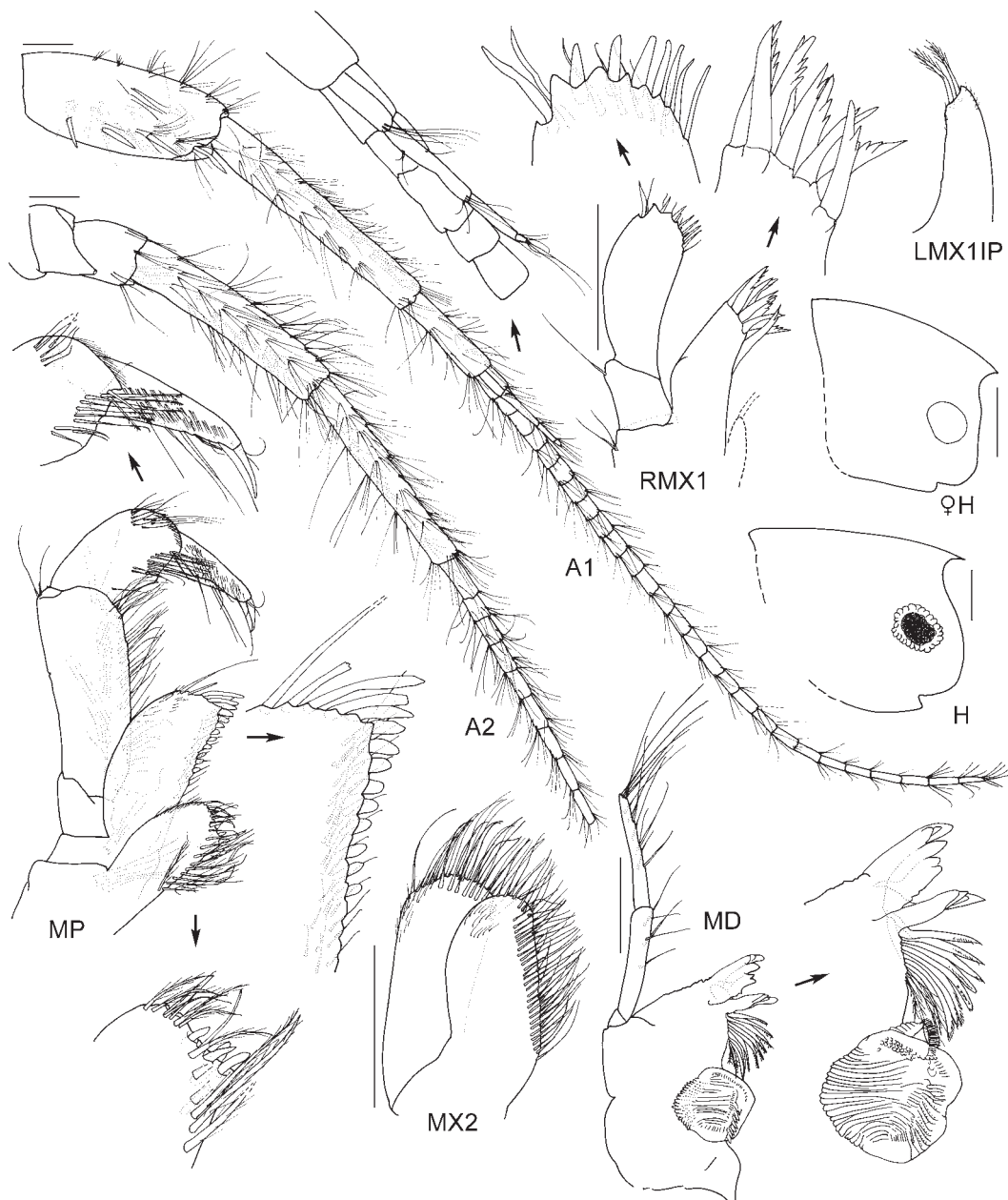


FIGURE 42. *Verdeia subchelata* (Schellenberg, 1925), male, 5.1 mm, 1 female, 7.8 mm, SAM A13565, west of Saldanhaabai, South Africa. Scales represent 0.2 mm.

Pleonite/urosomite dorsal spine formula (11-11-13-5-5-2). Pleonites 1–3 without dorsal setae. Epimeron 1 posteroventral corner with small acute or subacute spine. Epimeron 2 posteroventral corner produced, acute. Epimeron 3 posteroventral corner strongly produced, acute; posteroventral margin serrate distally. Urosomite 1 with 5 or 7 dorsal spines. Urosomite 2 with two groups of 1–3 small dorsolateral robust setae. Urosomite 3 without dorsal setae. Uropod 3 outer ramus long, about 2 x peduncle. Telson with dorsal robust setae.

Female (sexually dimorphic characters). Head lateral cephalic lobe broad, truncated. Gnathopod 1 propodus palm with posterodistal robust setae. Epimeron 2 posteroventral corner narrowly rounded or subquadrate.

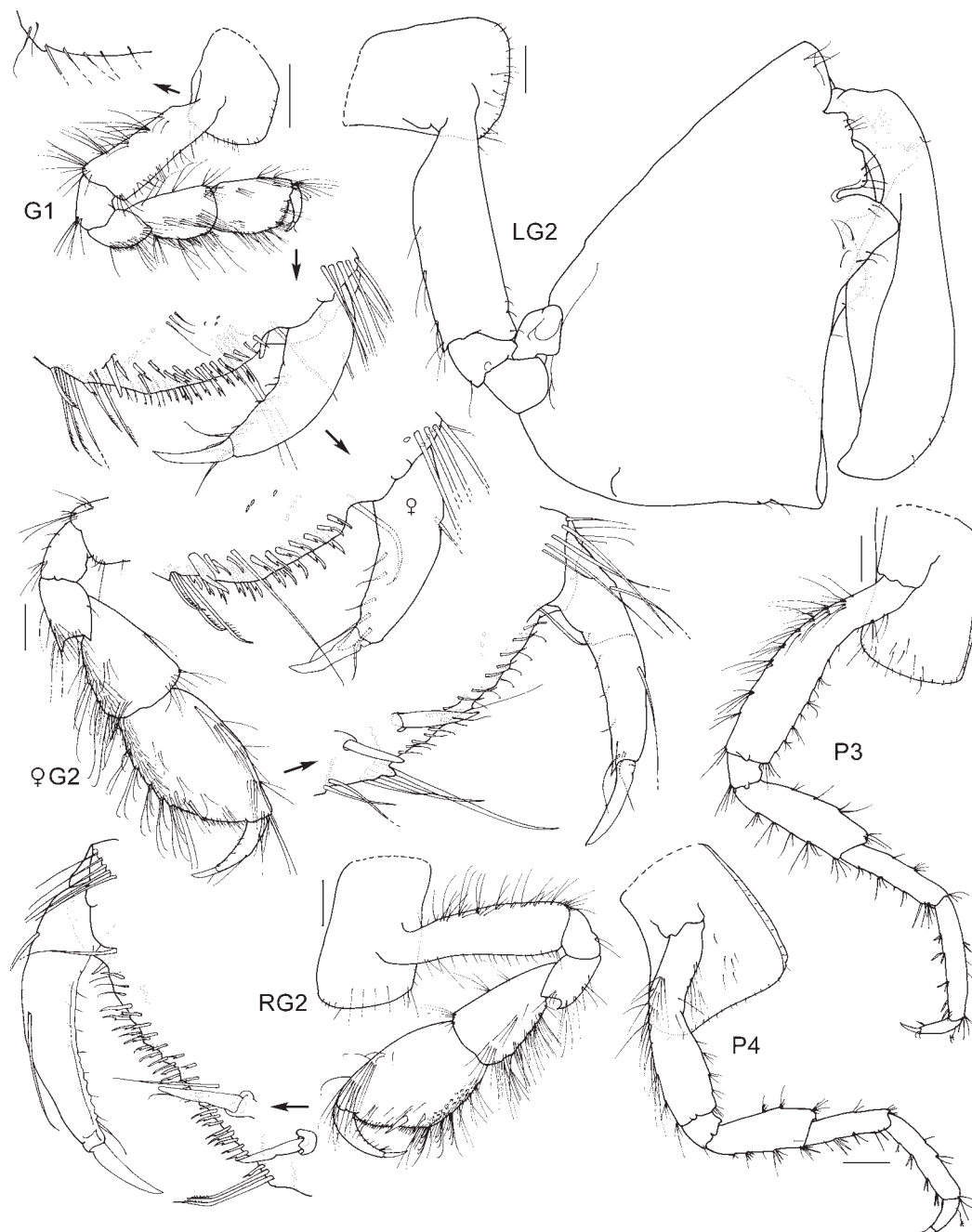


FIGURE 43. *Verdeia subchelata* (Schellenberg, 1925), male, 5.1 mm, 1 female, 7.8 mm, SAM A13565, west of Saldanha, South Africa. Scales represent 0.2 mm.

Habitat. Marine epibenthic.

Remarks. Schellenberg (1925) did not illustrate *Verdeia subchelata*. K.H. Barnard (1932), the first reviewer, illustrated an enlarged male gnathopod 2 and showed that this was a distinct species, but the figures here are the first complete illustrations of the species. Based on gnathopod 2, this species appears to be most closely related to *D. grandimana* from the Cape Verde Islands. The main differences are that *D. grandimana* has 3 spines on the palm of male gnathopod 2 and *D. subchelata* has 2 spines.

Distribution. Namibia: Lüderitz (Schellenberg, 1925); Walvis Bay (K.H. Barnard, 1932); Saldanha Bay (Griffiths, 1975).

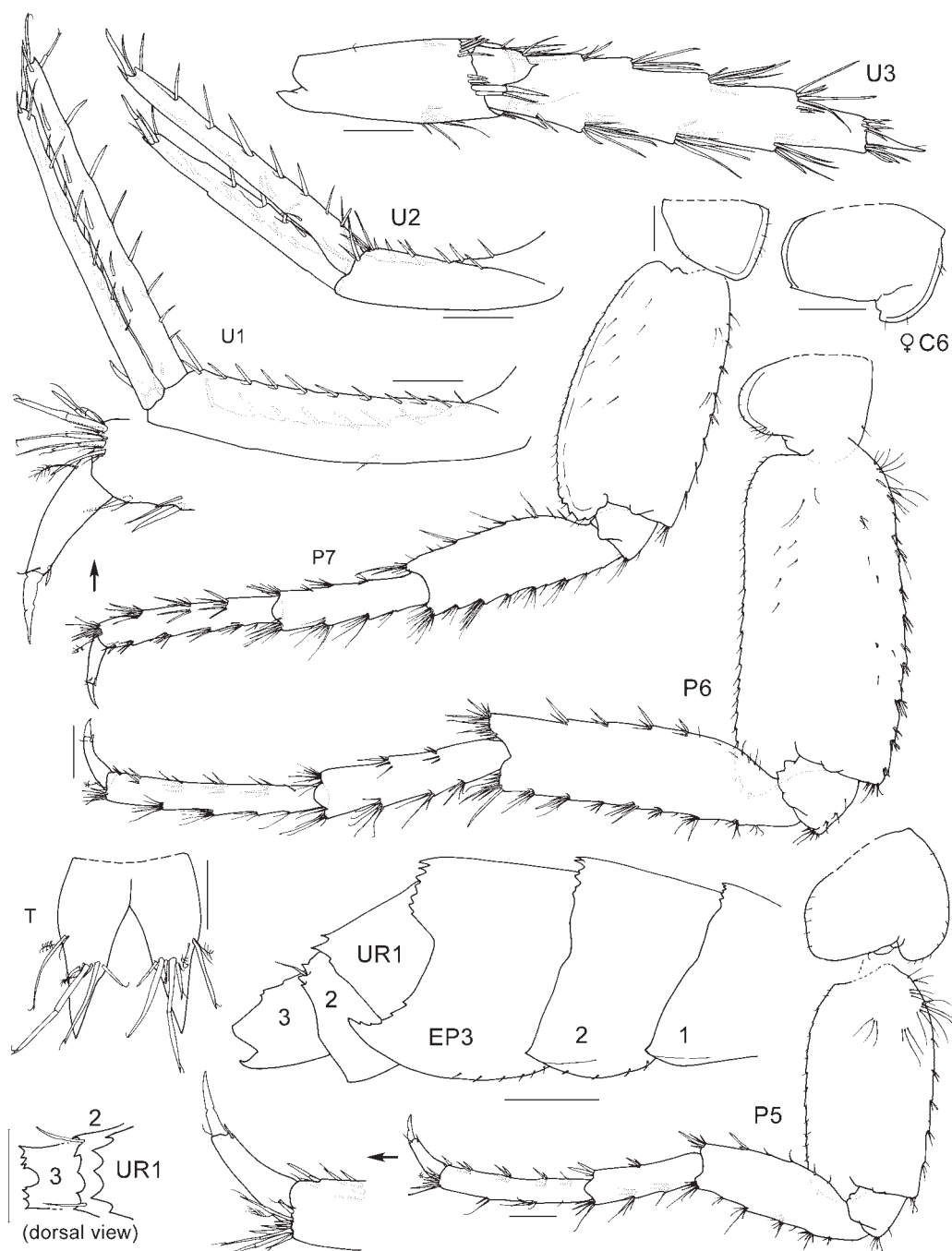


FIGURE 44. *Verdeia subchelata* (Schellenberg, 1925), male, 5.1 mm, 1 female, 7.8 mm, SAM A13565, west of Saldanhaai, South Africa. Scales represent 0.2 mm. posteroventral corner produced, acute.

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The basis of this study is the specimens of *Dulichella* held in museums around the world. Locating this material and borrowing it for study was essential and we are especially grateful to everyone who helped, particularly Don Cadien (Los Angeles County Sanitation Department), Susan Chambers (Royal Museum of Scotland, Edinburgh), Oliver Coleman (Zoological Museum, Alexander Von Humboldt University, Berlin), Danielle DeFaye (National Museum of Natural History, Paris), Peter Dworschak (Natural History Museum,

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References

- Appadoo, C. & Myers, A.A. (2005) Amphipods of the genera *Ceradocus*, *Dulichchiella*, *Melita* and *Nuuanu* (Crustacea: Melitidae) from Mauritius, Indian Ocean. *Records of the Australian Museum*, 57, 221–236.
- Audouin, V. (1826) Explication sommaire des planches de crustacés de l'Égypte et de la Syrie, publiées par Jules-César Savigny, membre de l'Institut; offrant un exposé des caractères naturels des genres, avec la distinction des espèces. *Description de l'Égypte, Histoire Naturelle*, 1, 77–98.
- Austin, W.C. (1985) *An Annotated Checklist of Marine Invertebrates in the Cold Temperate Northeast Pacific*. Khoysatan Marine Laboratory, Cowichan, B.C., 682 pp.
- Barnard, J.L. (1955) Gammaridean Amphipoda (Crustacea) in the collections of the Bishop Museum. *Bernice P. Bishop Museum Bulletin*, 215, 1–46.
- Barnard, J.L. (1962) Benthic marine Amphipoda of southern California: families Tironidae to Gammaridae. *Pacific Naturalist*, 3, 73–115.
- Barnard, J.L. (1965) Marine Amphipoda of atolls in Micronesia. *Proceedings of the United States National Museum*, 117, 459–551.
- Barnard, J.L. (1969) Gammaridean Amphipoda of the rocky intertidal of California: Monterey Bay to La Jolla. *Bulletin of the United States National Museum*, 258, 1–230.
- Barnard, J.L. (1970) Sublittoral Gammaridea (Amphipoda) of the Hawaiian Islands. *Smithsonian Contributions to Zoology*, 34, 1–286.
- Barnard, J.L. (1971) Keys to the Hawaiian marine Gammaridea, 0–30 meters. *Smithsonian Contributions to Zoology*, 58, 1–135.
- Barnard, J.L. & Barnard, C.M. (1983) Freshwater Amphipoda of the World. Vol. I. Evolutionary Patterns. Vol. II. Handbook and Bibliography. *Hayfield Associates, Mount Vernon, Virginia*, 830 pp.
- Barnard, K.H. (1916) Contributions to the crustacean fauna of South Africa. 5. —The Amphipoda. *Annals of the South African Museum*, 15, 105–302, pls 26–28.
- Barnard, K.H. (1932) Amphipoda. *Discovery Reports*, 5, 1–326, pl. 1.
- Barnard, K.H. (1937) Amphipoda. *Scientific Reports of the John Murray Expedition*, 4(6), 131–201.
- Bate, C.S. (1862) Catalogue of the Specimens of Amphipodous Crustacea in the Collection of the British Museum. *Trustees, British Museum, London*, 399 pp.
- Berents, P.B. (1983) The Melitidae of Lizard Island and adjacent reefs, The Great Barrier Reef, Australia (Crustacea: Amphipoda). *Records of the Australian Museum*, 35, 101–143.
- Bousfield, E.L. (1973). *Shallow-water Gammaridean Amphipoda of New England*. Cornell University Press, Ithaca and London, 312 pp.
- Chevreaux, E. (1908) Diagnoses d'amphipodes nouveaux provenant des campagnes de la *Princesse-Alice* dans l'Atlantique nord. (suite). *Bulletin De L'Institut Océanographique, Monaco*, 122, 1–8.
- Chevreaux, E. (1935) Amphipodes provenant des campagnes du Prince Albert Ier de Monaco. *Résultats des Campagnes Scientifiques Accomplies sur son Yacht par Albert Ier Prince Souverain de Monaco*, 90, 1–214, pls 1–16.
- Chilton, C. (1921) Report on the Amphipoda obtained by the F.I.S. "Endeavour" in Australian seas. *Biological Results of the Fishing Experiments carried on by the F.I.S. "Endeavour"*, 1909–14 5(2), 33–92.
- Dallwitz, M. J. (2005) Overview of the DELTA System. <http://delta-intkey.com/www/overview.htm>. 23/4/2006
- Dana, J.D. (1852) Crustacea. Part II. *United States Exploring Expedition during the years 1838, 1839, 1840, 1841, 1842 under the command of Charles Wilkes, U.S.N.*, 13, 689–1618.
- Della Valle, A. (1893) Gammarini del Golfo di Napoli. *Fauna und Flora des Golfes von Neapel*, 20, 1–948, pls 1–61.
- Duffy, E.J. & Hay, M.E. (2000) Strong impacts of grazing amphipods on the organization of a benthic community. *Ecological Monographs*, 70(2), 237–263.
- Feeley, J.B. & Wass, M.L. (1971) The distribution and ecology of the Gammaridea (Crustacea: Amphipoda) of the

- Lower Chesapeake Estuaries. V.I.M.S. *Special Papers in Marine Science*, 2, 1–58.
- Giles, G.M. (1890) Natural history notes from H.M. Indian Marine Survey Steamer 'Investigator', Commander Alfred Carpenter, R.N., D.S.O., commanding. No. 15. Descriptions of seven additional new Indian amphipods. *Journal of the Asiatic Society of Bengal*, 59(2), 63–74, pl.2.
- Griffiths, C.L. (1973) The Amphipoda of southern Africa. Part 1. The Gammaridea and Caprellidea of southern Moçambique. *Annals of the South African Museum*, 60(10), 265–306.
- Griffiths, C.L. (1974a) The Amphipoda of southern Africa. Part 2. The Gammaridea and Caprellidea of south west Africa south of 20°S. *Annals of the South African Museum*, 62(6), 169–208.
- Griffiths, C.L. (1974b) The Amphipoda of southern Africa. Part 3. The Gammaridea and Caprellidea of Natal. *Annals of the South African Museum*, 62(7), 209–264.
- Griffiths, C.L. (1975) The Amphipoda of southern Africa. Part 5. The Gammaridea and Caprellidea of the Cape Province west of Cape Agulhas. *Annals of the South African Museum*, 67(5), 91–181.
- Griffiths, C.L. (1976) Guide to the Benthic Marine Amphipods of Southern Africa. *Trustees, South African Museum, Cape Town*, 106 pp.
- Hale, H.M. (1927) The fauna of Kangaroo Island, South Australia. No. 1 — The Crustacea. *Transactions of the Royal Society of South Australia*, 51, 307–321.
- Haswell, W.A. (1879) On Australian Amphipoda. *Proceedings of the Linnean Society of New South Wales*, 4(3), 245–79, pls 7–12.
- Haswell, W.A. (1882) Catalogue of the Australian Stalk- and Sessile-eyed Crustacea. *Australian Museum, Sydney*, 324 pp.
- Hewatt, W.G. (1946) Marine ecological studies on Santa Cruz Island, California. *Ecological Monographs* 16: 185–210.
- Hirayama, A. (1986) Taxonomic studies on the shallow water gammaridean Amphipoda of West Kyushu, Japan. VI. Lysianassidae (*Orchomene*), Megaluropus family group, Melitides (*Cottesloe*, *Jerbarnia*, *Maera*, *Ceradocus*, *Eriopisella*, *Dulichella*). *Publications of the Seto Marine Biological Laboratory*, 3(1/2), 1–35.
- Hirayama, A. & Kikuchi, T. (1979) The first record of *Melita appendiculata* (Say) 1818, (Crustacea: Amphipoda: Gammaridae) from Japan. *Publications from the Amakusa Marine Biological Laboratory*, 5(1), 67–77.
- Hutchings, P., Van Der Velde J.T. & Keable, S.J. (1989) Baseline survey of the benthic macrofauna of Twofold Bay, N.S.W., with a discussion of the marine species introduced into the Bay. *Proceedings of the Linnean Society of New South Wales*, 110(4), 339–367.
- Irie, H. & Nagata, K. (1962) A list of the benthic Crustacea known in Ariake Sea. *Bulletin of the Faculty of Fisheries, Nagasaki University*, 13, 19–24.
- Ishimaru, S. (1994) A catalogue of gammaridean and ingolfiellidean Amphipoda recorded from the vicinity of Japan. *Reports of the Sado Marine Biological Station, Niigata University*, 24, 29–86.
- Jarrett, N.E. & Bousfield, E.L. (1996) The amphipod superfamily Hadzioidea on the Pacific coast of North America: Family Melitidae. Part 1. The *Melita* group: systematics and distributional ecology. *Amphipacifica*, 2(2), 3–74.
- Karaman, G.S. (1981) Redescription of *Melita planaterga* Kunkel 1910 from Bermuda islands with revision of genera *Melita* Leach and *Abludomelita* n. gen. (Contribution to the knowledge of the Amphipoda 119). *Poljoprivreda i Sumarstvo, Titograd*, 27(1), 29–50.
- Karaman, G.S. (1982) Family Gammaridae. *Mémoires de l'Institut Océanographique, Monaco*, 13, 245–364.
- Karaman, G.S. & Barnard, J.L. (1979) Classificatory revisions in gammaridean Amphipoda (Crustacea), Part 1. *Proceedings of the Biological Society of Washington*, 92, 106–165.
- Krøyer, H.N. (1845). Karcinologiske Bidrag. *Naturhistorisk Tidsskrift* series 2, 1, 283–345.
- Kunkel, B.W. (1910) The Amphipoda of Bermuda. *Transactions of the Connecticut Academy of Arts and Sciences*, 16, 1–116.
- LeCroy, S.E. (2000) An illustrated identification guide to the nearshore marine and estuarine gammaridean Amphipoda of Florida. *Annual Report for FDEP Contract Number WM724*, 1, i–iii, 1–195.
- Ledoyer, M. (1978) Amphipodes gammariens (Crustacea) des biotopes cavitaires organogènes récifaux de l'île Maurice (Océan Indien). *The Mauritius Institute Bulletin*, 8(3), 197–332.
- Ledoyer, M. (1979) Les gammariens de la pente externe du Grand Récif de Tuléar (Madagascar) (Crustacea Amphipoda). *Memorie del Museo Civico di Storia Naturale, Verona, series 2, Sezione Science della Vita*, 2, 1–150.
- Ledoyer, M. (1982) Crustacés amphipodes gammariens. Familles des Acanthonotozomatidae à Gammaridae. *Faune de Madagascar*, 59(1), 1–598.
- Ledoyer, M. (1986) Faune mobile des herbiers de phanérogames marines (*Halodule* et *Thalassia*) de la Laguna de Términos (Mexique, Campeche). II Les Gammariens (Crustacea). *Anales del Instituto de Ciencias del Mar y Limnología Universidad Nacional Autónoma de México*, 13(3), 171–200.
- Lowry, J. K. & Stoddart, H. E. (2003) Crustacea: Malacostraca: Peracarida: Amphipoda, Cumacea, Mysidacea. Beesley, P. L. and Houston, W. W. K., *Zoological Catalogue of Australia*, 19.2B, i–xii, 1–531, Melbourne, Australia, CSIRO Publishing.
- Lowry, J.K. & Springthorpe, R.T. (2005) New and little-known melitid amphipods from Australian waters (Crustacea:

- Amphipoda: Melitidae). *Records of the Australian Museum*, 57, 237–302.
- Marsh, G.A. (1973) The *Zostera* epifaunal community in the York River, Virginia. *Chesapeake Science*, 14, 87–97.
- Miers, E.J. (1875) Descriptions of new species of Crustacea collected at Kerguelen's Island by the Rev. A.E. Eaton. *Annals and Magazine of Natural History, Series 4*, 16, 73–76.
- Milne Edwards, H. (1830) Extrait de recherches pour servir à l'histoire naturelle des crustacés amphipodes. *Annales des Sciences Naturelles*, 20, 353–399, pls 10, 11.
- Milne Edwards, H. (1840) Histoire Naturelle des Crustacés, comprenant l'anatomie, la physiologie et la classification de ces animaux. *Librairie Encyclopedique de Roret, Paris*, 638 pp.
- Müller, F. (1864) Für Darwin. Wilhelm Engelmann, Leipzig. 91 pp.
- Myers, A.A. (1985) Shallow-water, coral reef and mangrove Amphipoda (Gammaridea) of Fiji. *Records of the Australian Museum, Supplement*, 5, 1–143.
- Nagata, K. (1964) [Gammaridea]. pp. 1–10 in T. Kikuchi (ed.) *Fauna and Flora of the Sea around the Amakusa Marine Biological Laboratory, Part V. Amphipod Crustacea*, Amakusa Marine Biological Laboratory, Kyushu.
- Nayar, K. N. (1959) The Amphipoda of the Madras coast. *Bulletin of the Madras Government Museum, Natural History Section*, 6(3), 1–59.
- Nayar, K. N. (1966) On the gammaridean Amphipoda of the Gulf of Mannar, with special reference to those of the pearl and chank beds. Proceedings of the Symposium on Crustacea held at Ernakulam from January 12 to 15, 1965. *Marine Biological Association of India*, 1966, 133–168.
- Ortiz, M. (1979a) Contribución al estudio de los anfípodos (Gammaridea) del Mediterráneo Americano. *Ciencias (La Habana), Series 8, Investigaciones Marinas*, 45, 1–16.
- Ortiz, M. (1979b) Lista de especies y bibliografía de los anfípodos (Crustacea: Amphipoda) del Mediterráneo Americano. *Ciencias (La Habana), Series 8, Investigaciones Marinas*, 43, 1–40.
- Ortiz, M. & Lalana, R. (1993) Adición a la lista de especies y bibliografía de los Anfípodos (Crustacea, Amphipoda) del Mediterráneo Americano. *Revista de Investigaciones Marinas*, 14(1), 16–37.
- Ortiz, M. & Lalana, R. (1997) Amphipoda. in M. Gutu (ed.) Results of the Zoological Expedition Organized by "Grigore Antipa" Museum in the Indonesian Archipelago (1991). 1. Peracarida (Crustacea). *Travaux du Muséum National d'Histoire Naturelle "Grigore Antipa"*, 38, 29–113.
- Pearse, A.S. (1912) Notes on certain amphipods from the Gulf of Mexico, with descriptions of new genera and new species. *Proceedings of the United States National Museum*, 43, 369–379.
- Pirlot, J.M. (1936) Les amphipodes de l'expédition du Siboga. Deuxième partie: Les amphipodes gammarides, II. — Les amphipodes de la mer profonde. 3: Addendum et partie générale. III. — Les amphipodes littoraux. 1: Lysianassidae, Ampeliscidae, Leucothoidae, Stenothoidae, Phliantidae, Colomastigidae, Ochlesidae, Liljeborgiidae, Oedicerotidae, Synopiidae, Eusiridae, Gammaridae. *Siboga-Expeditie, Monographie*, 33e, 237–328.
- Pirlot, J.M. (1939) Amphipoda. Résultats scientifiques des croisières du navire-école Belge 'Mercator'. Résultats Scientifiques des Croisières du Navire-École Belge 'Mercator'. *Mémoires du Musée Royal d'Histoire Naturelle de Belgique*, series 2, 15, 47–80.
- Poore, A.G.B. & J.K. Lowry (1997) New amphithoid amphipods from Port Jackson, New South Wales, Australia (Crustacea; Amphipoda: Amphithoidae). *Invertebrate Taxonomy*, 11, 897–941.
- Reid, D.M. (1951) Report on the Amphipoda (Gammaridea & Caprellidea) of the coast of tropical west Africa. *Atlantide Report*, 2, 189–291.
- Rudwick, M.J.S. (1951) Notes on some Crustacea (Amphipoda) from Aden. *Annals and Magazine of Natural History*, series 12, 4, 149–156.
- Say, T. (1818) An account of the Crustacea of the United States. *Journal of the Academy of Natural Sciences of Philadelphia*, 1, 374–401.
- Schellenberg, A. (1925) Crustacea VIII: Amphipoda. pp. 111–204 in W. Michaelsen (ed.) *Beiträge zur Kenntnis der Meeresfauna Westafrikas*. L. Friedrichsen & Co., Hamburg.
- Schellenberg, A. (1926) Die Gammariden der deutschen Sudpolar-Expedition 1901–1903. *Deutsch Sudpolar-Expedition* 18, 235–414.
- Serejo, C.S. (1998) Gammaridean and caprellidean fauna (Crustacea) associated with the sponge *Dysidea fragilis* Johnston at Arraial Do Cabo, Rio de Janeiro, Brazil. *Bulletin of Marine Science*, 61(2), 363–385.
- Sheridan, P.F. (1979) Three new species of *Melita* (Crustacea: Amphipoda), with notes on the amphipod fauna of the Apalachicola Estuary of northwest Florida. *Northeast Gulf Science*, 3(2), 60–73.
- Shoemaker, C.R. (1935) The amphipods of Porto Rico and the Virgin Islands. *Scientific Survey of Porto Rico and the Virgin Islands (New York Academy of Sciences)*, 15, 229–253.
- Shoemaker, C.R. (1941) On the names of certain California amphipods. *Proceedings of the Biological Society of Washington*, 54, 187–188.
- Shoemaker, C.R. (1955) Amphipoda collected at the Arctic Laboratory, Office of Naval Research, Point Barrow, Alaska, by G.E. MacGinitie. *Smithsonian Miscellaneous Collections*, 128(1), 1–78.
- Sivaprakasam, T.E. (1968) Amphipoda from the east coast of India. Part 1. Gammaridea. *Journal of the Marine Biologi-*

cal Association of India, 8(1), 82–122.

- Spandl, H. (1924) Die Amphipoden des Roten Meeres. Expeditionen S.M. Schiff "Pola" in das Rote Meer nordliche und sudliche Halfte 1895/96 — 1897/98. Zoologische Ergebnisse XXXV. *Denkschriften der Kaiserlichen Akademie der Wissenschaften, Wien. Mathematisch-Naturwissenschaftliche Klasse*, 99, 19–73, figs 1–23.
- Stebbing, T.R.R. (1906) Amphipoda. I. Gammaridea. *Das Tierreich*, 21, 1–806.
- Stebbing, T.R.R. (1910) Scientific results of the trawling expedition of H.M.C.S. "Thetis". Crustacea. Part V. Amphipoda. *Memoirs of the Australian Museum* 4, 565–658, pls 47–60.
- Stout, V.R. (1912) Studies in Laguna Amphipoda. *First Annual Report of the Laguna Marine Laboratory*, 134–149.
- Toth, E. & Duffy, J.E. (2005) Coordinated group response to nest intruders in social shrimp. *Biology Letters*, 1(1), 49–52.
- Wakabara, Y. & Serejo, C.S. (1998) Malacostraca — Peracarida. Amphipoda. Gammaridea and Caprellidea. pp. 561–594 in P.S. Young (ed.) *Catalogue of Crustacea of Brazil. Museu Nacional, Rio de Janeiro, Rio de Janeiro*.
- Wakabra, Y., Tararam, A.S., Valerio-Berardo, M.R., Duleba, W. & Pereira Leite F.P. (1991). Gammaridean and caprellidean fauna from Brazil. in L. Watling (ed.) VIIth International Colloquium on Amphipoda. *Hydrobiologica*, 223, 69–77.
- Walker, A.O. (1904) Report on the Amphipoda collected by professor Herdman, at Ceylon, in 1902. *Ceylon Pearl Oyster Fisheries — 1904- Supplementary Reports*, 17, 229–300, pls 1–8.
- Walker, A.O. (1909) Amphipoda Gammaridea from the Indian Ocean, British East Africa, and the Red Sea. *Transactions of the Linnean Society, London*, series 2, Zoology, 12(4), 323–44, pls 42–43.
- Wass, M.L. (1965) Check list of the marine invertebrates of Virginia. *Virginia Institute of Marine Sciences Special Scientific Report*, 24, 1–55.
- Wass, M.L. (1972) A check list of the biota of Lower Chesapeake Bay with inclusions from the Upper Bay and the Virginian Sea. *Virginia Institute of Marine Sciences Special Scientific Report*, 65, 1–290.
- Watling, L. & Maurer, D. (1972) Marine shallow water amphipods of the Delaware Bay area, U.S.A. *Crustaceana, Supplement*, 3, 251–266.